Innovative approaches
Practical results
Outstanding service

FLOODPLAIN MANAGEMENT PLAN

Prepared for:

City of Fort Worth

September 2015

DRAFT

Prepared by:

FREESE AND NICHOLS, INC.
4055 International Plaza, Suite 200
Fort Worth, Texas 76109
817-735-7300

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EXECUTIVE SUMMARY

The City of Fort Worth experiences flooding every year. The purpose of this report is to document the flood hazards and their impact on the City, identify possible mitigation actions, and create a Mitigation Action Plan with input from relevant stakeholders. Because this report was created in support of the National Flood Insurance Program (NFIP), it focuses on flooding within the FEMA floodplain. It does recognize that Fort Worth has significant urban flooding problems outside of the FEMA floodplain that warrant a similar effort.

This document begins with general background information about Fort Worth and is then organized into ten sections. These ten sections correspond with the ten steps explained in Section 510 of the *Community Rating System Coordinator's Manual* (*CRS Manual*) and are listed below:

1. Organize
2. Involve the Public
3. Coordinate with Other Agencies
4. Assess the Hazards
5. Assess the Problems
6. Set Goals
7. List Possible Activities
8. Create a Mitigation Action Plan
9. Adopt the Plan
10. Implement, Evaluate, and Revise the Plan

Using the FEMA HAZUS software, the problem assessment revealed there could be $1.5 billion in property damage due to flooding within the FEMA floodplain in a 100-year flood event. It also showed that 83% of buildings within the 100-year floodplain have no flood insurance policy. The plan also documents that the higher floodplain standards required by Fort Worth have been very effective at reducing flood insurance claims, including 88% reduction in the number of claims, and 84% reduction in total value of claims.

A Stakeholder Planning Group was formed from City staff, business representatives, and residents. This group met three separate times. In addition, two public meetings were held in an effort to gather input. A Mitigation Action Plan was created by categorizing actions into the following six categories:

- Preventative Activities
- Property Protection
- Natural Resource Protection
- Emergency Services
- Structural Projects
- Public Information

Each activity was given a priority ranking, an estimated cost range, and a timeline. The Mitigation Action Plan is found starting on page 46.

Completion of this plan will help the City increase its Community Rating System (CRS) score. The City has self-scored the plan, which can be found in Appendix E.

INTRODUCTION

The City of Fort Worth contracted Freese and Nichols Inc. (FNI) to assist in preparing a city-wide Floodplain Management Plan (FMP) according to the FEMA *CRS Manual* Section 510. The purpose of this plan is to identify the flood risk within the City and propose a prioritized Mitigation Action Plan to reduce that risk. Additionally, the City intends to submit this FMP to improve their overall CRS classification.

The expected outcomes of this FMP are as follows:

- Identify the City's flood hazard areas and address the community's flood hazards more effectively
- Produce a prioritized action plan of activities that will help mitigate the community's vulnerability to the hazard of flooding
- Ensure that recommended activities provide appropriate solutions addressing the hazards of flooding faced by existing and new development
- Ensure that recommended activities do not create conflicts with other flood hazard solutions and can be implemented in a cost effective manner
- Educate residents about flooding hazards, loss reduction measures, and the natural and beneficial functions of floodplains
- Build public and political support for projects that prevent new problems, reduce losses, and protect the natural and beneficial functions of floodplains
- Build a constituency that will implement the recommendations made for preventing and preparing for flood hazards

This document begins with general background information about Fort Worth and is then organized into ten sections. These ten sections correspond with the ten steps explained in Section 510 of the *CRS Manual* and are listed below:

Step 1. Organize

Step 2. Public Involvement

Step 3. Coordination with other Agencies

Step 4. Hazard Assessment

Step 5. Problem Assessment

Step 6. Goals

Step 7. Possible Activities

Step 8. Action Plan

Step 9. Adoption of the Action Plan

Step 10. Implementation, Evaluation, and Revision of the Action Plan

The plan was developed with significant input and direction from a Stakeholder Planning Group comprised of City staff and representatives from the public. More information about the Stakeholder Planning Group is available in the Step 1 section.

BACKGROUND INFORMATION

LOCATION

The City of Fort Worth lies approximately 35 miles west of Dallas in North Central Texas and primarily in the borders of Tarrant County, with outcrops in Denton, Parker, Johnson and Wise Counties. The City covers approximately 349 square miles and serves as the county seat for Tarrant County. Table 1 shows the land area of Fort Worth compared to the land area of Tarrant County. Exhibit 1 in Appendix A shows a map of the city boundaries of Fort Worth in relation to Dallas and other surrounding cities.

Table 1: Land Area in Square Miles

City of Fort Worth	349.20
Tarrant County	863.61

CLIMATE

The City's climate is humid subtropical with hot summers and winters with short periods of extreme cold. The area experiences a wide annual temperature range, according to the National Weather Service. The mean temperatures in the City range from 96° F in the summer and 35° F in the winter. On average, the City receives approximately 38 inches of precipitation annually.

POPULATION

Fort Worth is the 17th largest city in the United States of America and the fifth largest in Texas. The City is estimated to have a population of 741,206 based on the 2010 Census and a population estimate of 792,720 in 2015, according to the North Central Texas Council of Governments (NCTCOG). In 2000, the population was recorded to be 545,993, which makes a 35.7% growth in population from 2000-2010. The Texas Water Development Board (TWDB) projects the population to be 2,161,533 by 2060 in their *2011 Region C Water Plan*.

LAND USE

The City has a variety of land uses including residential, industrial, commercial, office, and recreational areas to meet the needs of the community and economy within the City. Refer to Exhibit 2 in Appendix A for a current and future land use overview of the City.

ECONOMY

Fort Worth, Texas was settled in 1849 as an U. S. Army outpost at the confluence of the West and Clear Forks of the Trinity River. The settlement was designed to protect settlers from Indian attacks. Fort Worth became the last major stop on the Chisholm Trail, a route to drive cattle from Texas to meat slaughter houses in Kansas. As a result, Fort Worth's economy was founded on the cattle business. The oil boom in the early 20th century also helped Fort Worth's economy grow.

Today, the main industries in Fort Worth are educational services, health care, and social assistance as well as professional, scientific, management, administrative, and waste management services. Companies such as American Airlines, Burlington Northern Santa Fe Railway, Pier 1 Imports, Acme Brick, Justin Brands, GE Manufacturing Solutions, and RadioShack are headquartered in Fort Worth. The Fort Worth Zoo, Fort Worth Stockyards, Texas Cowboy Hall of Fame, and the City's many museums make tourism a strong part of Fort Worth's economy as well.

Table 2 shows the family median income in Fort Worth as compared to the family median incomes of Texas and the United States.

Table 2: U.S. Census Bureau 2010 Family Median Income

Fort Worth	$56,194
Texas	$58,929
United States	$62,735

NFIP PARTICPATION

The City began participating in FEMA's NFIP in 1980 and the CRS Program in 2012. The City is classified as a Category C repetitive loss community, and currently holds a Classification of 8 in the CRS Program. The CRS Program gives a classification from 1-10, where 1 is the best score a city can achieve within the CRS Program. Based on FEMA Repetitive Loss Records, the City has 44 repetitive loss properties (RLP). RLPs are those properties for which two or more claims of more than $1,000 have been paid by the NFIP within

a 10-year rolling period since 1978. Nationwide RLP's represent only 1% of all the NFIP's insurance policies, but they have accounted for nearly one-third of the claim payments. Fort Worth's RLAs represent 0.5% of the flood insurance policies held in the city limits and account for approximately 17% of the paid insurance claims.

STEP 1. ORGANIZE

The first step in the FMP development process is to organize to prepare the plan. Organization includes gathering and assessing the City's existing resources and relevant data to be incorporated into the plan. This step also involves forming a Stakeholder Planning Group of staff members and public representatives to assist in the development of the plan.

INCORPORATION OF EXISTING DATA

During the planning and development of the plan, various existing plans, studies, reports and technical information were reviewed and incorporated into the FMP, as shown in more detail in Table 3.

Table 3: Review and Incorporation of Existing Resources

Existing Resource	How Resource was Used
Citywide Dam Safety Assessment (City of Fort Worth 2011)	Step 4 to evaluate flood risk associated with Dams
National Flood Insurance Program Community Rating System Coordinator's Manual (FEMA 2013)	Used the ten steps of floodplain management (Section 510) as a guide to create the main body of this document and to guide the planning process.
Flood Insurance Study for Tarrant County, TX (FEMA 2009)	Source for information about flooding sources including depths and velocities. Most of the discussion of past floods in Step 4 is from this document.
Hazard Mitigation Action Plan (HazMap) (City of Fort Worth last updated 2015)	Used for background information and in Step 4 to identify known flood hazards and evaluate levees
CIP and Studies List (City of Fort Worth 2015)	Steps 4 and 7 to identify which areas have completed or planned studies and/or capital improvement projects
Flood Warning System Study (City of Fort Worth 2014)	Information from this study is incorporated into Step 4
Flood Insurance Claims (City of Fort Worth 2015)	Step 5 to identify flood problem areas
Critical Infrastructure/Key Resource Summary 06-26-15 (City of Fort Worth)	Step 5 to assess the flood risk to critical facilities

Existing Resource	How Resource was Used
GIS Data from City of Fort Worth: 1. Repetitive Loss Areas/Properties (2015) 2. Most Recent SFHA Layer (2015) 3. Open Channel Study GIS Data 4. Dams and Levees 5. Zoning 6. Low Water Crossings 7. Building Footprints 8. Parcel Data 9. Bridge Inventory 10. Flood Warning System 11. Areas of Potential High Water 12. Drainage Complaints Database 13. Finished Floor Elevations where available	Steps 4 and 5 to perform analyses, create exhibits, and conduct HAZUS assessment
Runoff Rundown Newsletter (City of Fort Worth)	Step 2 for public outreach
Fort Worth Stormwater Management website http://fortworthtexas.gov/stormwater/ http://fortworthtexas.gov/stormwater/floodplain/ https://mysidewalk.com/sidewalks/3128/fort-worth-tx	Steps 2 and 4 for public outreach and identifying problem areas
HAZUS software (FEMA)	Step 5 to perform problem assessment
Operation and Maintenance Manual West Fort-Clear Fork, Trinity River (USACE)	Step 4 for background information on levee systems
City of Fort Worth Floodplain Ordinance	Step 7 for review of possible activities
City of Fort Worth iSWM Criteria Manual for Site Development and Construction - August 1, 2012	Step 7 for review of possible activities

FLOODPLAIN MANAGEMENT PLAN STAKEHOLDER PLANNING GROUP

The City formed a Stakeholder Planning Group to participate in the planning process of the FMP in order to provide input into the plan's content. The City staff selected members and stakeholders to represent comprehensive and diverse organizations and perspectives for the FMP planning process. Members of the Stakeholder Planning Group represent various departments within the City as well as a variety of interests from the public. The Stakeholder Planning Group members were then personally invited to join either by phone or email from the City Floodplain Administrator, Clair Davis. This group consisted of six City staff members and 13 members from the public sector including residents, landowners, developers, engineers, small business owners, insurance agents, and real estate professionals. Many of the residents

were invited because of their previous experiences with flooding and participation with the City's various committees. Table 4 lists the Stakeholder Planning Group members who accepted invitations to participate in the FMP planning process.

Table 4: FMP Stakeholder Planning Group Members

Name	Department/Representation	Public/City Staff
La Wayne Hauser	Resident	Public
Libby Willis	Resident, League of Neighborhoods	Public
Rick Kubes	Resident and Small Business Owner	Public
Ron Shearer	Resident	Public
Mary Kelleher	Resident	Public
Larry Langston	Resident	Public
Bobbie Shosty-McCurdy	Resident	Public
Joe Waller	Resident	Public
Kent Lloyd	Insurance	Public
Jim Austin	Real Estate	Public
Mike Dellies	Development Community – Engineer	Public
Joe Schneider	Development Community	Public
Mikel Wilkens	Environmental Engineer – Sustainability	Public
Clair Davis	Floodplain Administrator	City Staff
Linda Sterne	Stormwater Public Involvement Officer	City Staff
Joel McElhany	Parks and Community Services Department	City Staff
Jennifer Dyke	Stormwater Planning	City Staff
Juan Ortiz	Office of Emergency Management	City Staff
Eric Fladager	Planning and Development	City Staff

The Stakeholder Planning Group played a crucial role in making decisions regarding the selection of FMP goals and hazards, developing mitigation goals and actions, and reviewing the document to provide comments. The Stakeholder Planning Group held three formal meetings outside of the City's Council meetings and separate from the public meetings discussed in the next section to discuss the information regarding each of the steps involved in the FMP. Meeting notices were posted on the project website, and the meetings were open to the public if they chose to participate. Additional coordination was performed with the Stakeholder Planning Group through email and phone to keep them involved throughout the development of the plan.

Table 5 summarizes the Stakeholder Planning Group meeting dates and topics covered at each meeting. A more detailed discussion of each meeting is included in this section, and all meeting minutes are included in Appendix B.

Table 5: Stakeholder Planning Group Meeting Dates and Steps Discussed

Meeting	Date	Steps Discussed
Meeting #1	May 18, 2015	Step 1: Organize Step 2: Involve the Public Step 3: Coordinate Step 6: Set goals
Meeting #2	August 4, 2015	Step 4: Assess the hazard Step 5: Assess the problem Step 7: Review possible activities Step 8: Draft an Action Plan
Meeting #3	October 6, 2015	Step 8: Draft an action plan Step 9: Adopt the plan Step 10: Implement, evaluate, revise Review Final Draft of FMP prior to adoption

Stakeholder Planning Group Meeting #1 - May 18, 2015

The first Stakeholder Planning Group meeting focused on introducing the FMP and its purpose. Steps 1 through 3 and Step 6 of the FMP were discussed in detail. Mr. Clair Davis of the City gave a presentation about the flooding history of Fort Worth, the NFIP, and the CRS. Many of the Stakeholder Planning Group members shared their personal flooding experiences. Mr. Scott Hubley of FNI discussed the purpose of a floodplain management plan and how it relates to the CRS and flood insurance. He also explained the role of the Stakeholder Planning Group. An open discussion was then held by the Stakeholder Planning Group to determine goals for the FMP. Some of the main points of this discussion are as follows:

- There needs to be more effort educating the public about flood risks, flood insurance, and what is not covered on homeowner's insurance.
- Floodplain development should consider future fully-developed conditions, not only existing conditions.
- Protect and use open property for ponds and parks, especially mapped floodplain areas.
- Drones could be used in the future to more thoroughly evaluate flood problems.
- A blog or Facebook page should be used to gather ideas and comments from the rest of the public.

The timeline of the project and future meetings were also discussed. The identified next steps were to hold a public meeting, prepare a hazard assessment profile for the City, and prepare for the next Stakeholder Planning Group meeting.

Stakeholder Planning Group Meeting #2 - August 4, 2015

The second Stakeholder Planning Group meeting focused on reviewing Steps 4 through 8 of the FMP. Each stakeholder was provided with a copy of the draft FMP for their review and input. The hazard assessment, problem assessment, goals, and possible actions were discussed with the attending group members. The group offered suggestions for improvements on each part of the plan, and the suggestions are documented in the meeting minutes. The Stakeholder Planning Group also brainstormed and recorded ideas for the mitigation actions for each of the six types of possible activities listed in the *CRS Manual*. The meeting minutes, attendance sheet, and list of suggested mitigation activities are included in Appendix B.

STEP 2. PUBLIC INVOLVEMENT

The City's FMP planning process allowed the opportunity for the public to be involved in the plan development. The City provided several avenues of public outreach and education during the plan development. The City also provided several opportunities throughout the planning process for the public to submit comments.

PUBLIC MEETINGS

The City held two public meetings during the planning process that were dedicated to educating the public about the FMP and receiving feedback from residents. These meetings were separate from the Stakeholder Planning Group meetings and routine City Council meetings. Table 6 summarizes the dates and discussion topics at each public meeting. Further descriptions can be found in the following paragraphs, and meeting minutes are included Appendix B.

Table 6: Public Meetings

Meeting	Date	Steps Discussed
Public Meeting #1	June 1, 2015	Steps 1-3, 6
Public Meeting #2	September 28, 2015	Steps 4-10 and Review of Draft Document

The first public meeting was held on Monday, June 1, 2015 at the Hazel Harvey Peace Center for Neighborhoods, 818 Missouri Avenue, Fort Worth, TX 76104. This location is near an area of known flooding, the Near Southside neighborhood. The meeting was advertised via Facebook, Twitter, and the City website. It was also posted on the City Hall weekly calendar of events and an announcement was sent out to all of the neighborhood associations. Appendix B documents the City's efforts to inform the public about this meeting and encourage participation. In attendance were four personnel from the City, four personnel from FNI, two personnel from Open Channels (public relations sub consultant to FNI), and 26 other attendees including residents, land owners, and business owners.

Residents and business owners of the City were given the chance to place stickers on maps at their homes or anywhere else they had observed flood problems. This exercise assisted the City in identifying known flood hazards described in Step 4 of this plan. The public meeting involved a presentation given by City staff and FNI. City staff discussed an overview of Fort Worth's flooding history, participation in the NFIP, and the CRS program. FNI then discussed the purpose and process of developing a floodplain management plan. The full presentation is included on the CD in Appendix F.

Time was given for the public to voice their concerns and provide input to the plan development process. Comment cards and surveys were provided to the public as well as brochures on flood preparation and flood insurance. A blank copy of this comment card/questionnaire can be seen in Appendix B. There were many questions and comments from the public during the meeting and 20 comment cards were submitted at the end of the meeting. The public's feedback from these comment cards can be found in Table C-1 in Appendix C. During the meeting, residents voiced their concern for impacts due to new developments. They indicated a desire to see stricter stormwater and floodplain regulations. Maintenance of storm drains to prevent clogging and pollution was also of concern. These concerns were noted to be used when determining the possible activities the City can use to mitigate flood risk during Step 7 of this plan. WFAA, the ABC local news affiliate, sent a reporter and camera crew to the meeting providing further public outreach. There was a two-minute story about the meeting and the FMP later that evening on a local news station. The news report can be viewed online at the following link:

http://www.wfaa.com/story/news/local/tarrant-county/2015/06/01/fort-worth-looks-revamp-flood-plan-after-drenched-spring/28334759/

The second public meeting was held at the same location on September 28, 2015 at 6:00 p.m. This meeting was advertised on Facebook, Twitter, the City's calendar, the City's website, and through the

neighborhood associations just like the first meeting. The efforts to publicize this meeting can be found in Appendix B. In attendance were four City staff, three FNI personnel, one personnel from Open Channels (public relations sub consultant to FNI), and six other attendees including students, residents, and landowners.

In this meeting, a brief review of the NFIP was given as well as the purpose of the FMP. Steps 1-7 were quickly summarized followed by a discussion of the Mitigation Action Plan in Step 8. The attendees were then given the chance to make comments and ask questions. The residents voiced a desire that stormwater improvement projects should be evaluated after completion to see if they accomplish their purpose. They also voiced a desire for site visits done by City staff as well as stricter regulations concerning floodplain development.

PUBLIC OUTREACH

Several additional public outreach projects were completed to provide residents a chance to voice their concerns about flooding and provide suggestions on how to reduce flood risk in the City. Every resident with the desire to participate has had ample opportunity to participate and learn about flood prevention and protection through the public meetings or public outreach projects. A total of six different outreach methods were utilized to promote public participation in the plan.

City Website

The City created a website dedicated to the FMP to provide information and allow for feedback and input from the community regarding the plan. This website is linked to the City's Stormwater Management site and can be found at http://fortworthtexas.gov/stormwater/floodplain/. The website describes the FMP process, lists upcoming meetings and allows for the download of presentations and minutes from previous meetings.

City News Article

The City of Fort Worth also posted an article on the City News website encouraging resident participation. The article can be found at the following link:

http://fortworthtexas.gov/citynews/default.aspx?id=141876.

The article gave a brief summary of the FMP effort, its purpose, and a link to the previously mentioned website as well as encouragement to attend a public meeting. City News is a weekly news update posted on the City website which is monitored by the media and distributed by email to all subscribers, including contacts for each of the citywide neighborhood associations.

Online Questionnaire

Survey questions were also posted on the City's "mySidewalk" page to provide the public with another opportunity to voice their experiences with flooding and provide suggestions for types of mitigation actions. The "mySidewalk" account is an online forum where the City regularly posts questions to receive input from the public regarding a number of topics, including transportation, flooding, etc. Questions regarding the FMP were periodically added throughout the planning process to solicit input from the public to guide the plan. The first three questions were posted on June 24, 2015 and focused on gathering information about known flood hazards and public opinion about flooding in Fort Worth. The next three questions, posted on August 14, 2015, asked what types of flood mitigation activities residents would support, specifically, preventative activities, property protection, and natural resource protection. The final round of questions in September 17, 2015 asked if the residents would support emergency services, structural projects, and public information activities to reduce flood risk within the City. The responses to these questions are found in Table B-1, also in Appendix B.

Direct Mail Newsletter

The City created and mailed an informational booklet entitled the *Runoff Rundown* to every resident with a Fort Worth mailing address. The booklet includes information about flood insurance, property protection, floodplain development requirements, flood safety, and other stormwater and floodplain topics. This booklet also directs the public to the city website for additional information regarding flood risk reduction. Runoff Rundown is intended to inform those who do not regularly visit the city website and those who do not use the internet, such as elderly residents. A mention of the FMP and upcoming public meeting was included in the August/September 2015 edition of the newsletter.

Social Media Campaign

The City conducted a social media campaign as an outreach project. Social media is a flexible and inexpensive way to reach a wide audience in a timely manner. The FMP was initially promoted through

social media on the City's Facebook and Twitter accounts. Then each public meeting was advertised through the social media accounts. Copies of these efforts are included in Appendix B.

Neighborhood Email Blasts

The City employs staff dedicated to communicating with neighborhood associations within the City. One of the primary methods of communication is through email blasts that are distributed to every neighborhood association. The FMP was promoted through several email blasts. Copies of the announcements are included in Appendix B.

STEP 3. COORDINATION WITH OTHER AGENCIES

There is a possibility that neighboring communities already conducted studies which included portions of local streams and stormwater infrastructure surrounding or within the Fort Worth city limits. These studies would likely have existing data, plans, or reports that would assist the City with this FMP and reduce the potential for duplicating flood protection efforts. There also may be flood protection activities considered or implemented by other agencies that could impact the City. In an effort to glean additional information that could benefit the City, letters were sent to neighboring communities and local and regional agencies giving them an opportunity to be involved in the planning process and to provide input pertinent to the City's FMP. The letter is included in Appendix D. The people and organizations that received this letter of inquiry are listed in Table D-1 of Appendix D. Responses from these agencies are also included in Appendix D.

STEP 4. HAZARD ASSESSMENT

This hazard assessment is composed of three parts: a discussion of past floods in the City, known flood hazards, and an assessment of the less-frequent flood hazards. The past floods are described based on historical records documented in the Flood Insurance Study (FIS) and recent events represented in the FIS and with data provided by the City. The known flood hazards were identified through various sources and include flooding due to both streams and undersized storm drain infrastructure. Less frequent hazards include the dams and levees within the City.

In order to guide the hazard assessment process, a CRS Self-Assessment was completed for the City. Topics and answers to questions in the CRS Self-Assessment provided content included within this hazard assessment. The data from Tables 4.1, 4.2, and a large part of the GIS information on the exhibits in

Appendix A were formed while completing the CRS Self-Assessment. The results from the CRS Self-Assessment can be found on the CD in Appendix F. In addition, a self-scoring evaluation was completed using the scoring breakdown found in the *CRS Manual*. The self-scoring can be found in Table E-1 of Appendix E.

DISCUSSION OF PAST FLOODS

The City has experienced a number of major flood events in its history. The following are brief descriptions of past flood events that have affected the City. Many of these descriptions are taken from the FEMA FIS for Tarrant County, TX (2009) .

Large floods occurred in the Bear Creek Watershed in 1935, 1942, 1949, 1957, 1962, 1964, and 1966 (Reference 39). Other lesser floods have occurred, such as those on May 7, 1969 and June 1961. However, little definite information is available on them. The USGS has maintained a stream gaging station on Bear Creek at State Highway 26 (Old Highway 121) since 1966. The historical flood information on Big Bear and Little Bear Creeks was obtained from the Bear Creek floodplain information report published in 1971. Significant floods occurred in the Little Bear Creek Watershed seven times during the period from 1935 to 1966. The most substantial flood in this period occurred in September 1964.

Large floods occurred in the Big Fossil Creek Watershed in September 1900, May 1908, April 1922, September 1932, April 1942, May 1949, May 1957, October 1959, June 1961, September 1962, September 1964, March 1968, and October 1981. Heavy rains on April 26, 1958, resulted in flash flooding on Little Fossil Creek and caused a death by drowning at a low water crossing. Another flood-related drowning occurred on March 20, 1968 on Little Fossil Creek downstream of the City of Blue Mound, a small independent city inside the borders of Fort Worth.

Historical flood information on Marine Creek began in 1907; however, no stage elevation data are available. Large floods occurred on Marine Creek in 1908, April 1922, February 1938, April 1942, and 1957. The largest known flood occurred in April 1942, with an estimated discharge of 22,300 cubic feet per second (cfs).

Large floods are known to have occurred in April 1922 and May 1949 in the Mary's Creek Watershed. No estimate of the recurrence intervals of these floods is available.

Floodwaters from Calloway Branch caused damage to structures in October 1971, September 20, 1974, and in October 1981.

The USGS has maintained a gaging station on Sycamore Creek at the upstream side of Interstate Route 35W since 1969. From this source and the Texas Department of Highways and Public Transportation (TxDOT), it is known that major floods occurred in 1938, 1977, and 1979.

A search of the historical information indicates that large flows occurred on the West Fork Trinity River in May 1866, May 1908, April 1922, June 1941, May 1949, May 1957, and November 1981. The May 1866 flood caused considerable damage along the Trinity River, but no specific data related to this flood are available. The May 1908 flood produced a peak discharge of measured at 184,000 cfs in nearby Dallas County. Based on present conditions, a flood of this magnitude would have a recurrence interval of approximately 500 years. No major floods have occurred on the Clear Fork of Trinity River in the Benbrook area since Lake Benbrook was put into operation in 1952.

Figure 1: Fort Worth on May 17, 1949

Recent Flood Events

Generally, the major floods experienced in Fort Worth are produced by heavy rainfall from frontal type storms which occur in the spring and summer months. Major flooding can be produced by the intense rainfall usually associated with localized thunderstorms. These thunderstorms may occur at any time during the year but are more prevalent in the spring and summer months. The topography of Fort Worth combined with the frequency of severe thunderstorms results in frequent flash flood events especially on small creeks and urban drainage systems. There have been 17 deaths in Fort Worth due to flash flooding on roadways between 1986 and 2008. Fort Worth is also close enough to the Gulf of Mexico that it can be affected by tropical storm systems on occasion. Some examples of this are Tropical Storm Hermine (2010) and Tropical Storm Bill (2015). These storms often have lesser intensities but larger volumes of rainfall which can lead to river flooding.

Between 1993 and 2006, the National Weather Service reported 155 flash flood events in Tarrant County. Minor flooding occurs frequently, especially during the spring and early summer. Recent significant events include:

- June 2000- Rains up to 11 inches fell in a few hours on the far west side of the Fort Worth causing major damage to homes and streets.
- June 2004- Significant flooding occurred in many other parts of the City following heavy rain. Homes, businesses, the Fort Worth Zoo, and electric utilities were affected by the flooding.
- June 2007- Heavy rains damaged or destroyed several homes in far north Fort Worth.
- May 2015- Several consecutive nights of heavy rain resulted in the Trinity River flooding many parts of the City. Heavy rain also overloaded and caused flooding in areas away from the rivers and creeks. Over a two-day period, there were 55 reported high water incidents, including 34 roads overtopping.

These historical and recent flood events assist the City in knowing where there are flood hazards and the magnitude of damage a flood can cause. The next section describes known flood hazards within the City.

KNOWN FLOOD HAZARDS

The first step in mitigating flood concerns is knowing where those flood hazards exist, including the source, depth, velocity, and warning times. Flooding is one of the most common hazards affecting communities across the country. Flooding can impact area that range in size from small communities to large regions. Regardless of whether a flood occurs over a period of minutes or days, floods have significant probability of causing extensive property damage, disabling critical facilities, and also threatening the safety of the public. Known sources of flooding within the City include rivers, streams, lakes, and storm drain infrastructure. Existing data, including FEMA Special Hazard Flood Zone areas, RLPs, drainage complaints, and studies identifying flooding outside of the floodplain were used to assess the flood hazard within the City. Exhibit 3 in Appendix A summarizes the known flood hazard areas on a map. The data in this map are also recorded in ArcGIS format so the City can easily access and update the information associated with the flood hazards.

Floodplains

A common source of flooding is water from streams overtopping roadways or stream banks and backwater from streams into closed storm drain systems. Numerous streams and rivers flow through the City. Many of the 100-year and 500-year floodplains are mapped on Federal Insurance Rate Map (FIRM)

or studied by the City. The floodplains are one way to identify locations of known flood hazards due to riverine flooding. This section includes a discussion of the major streams through the City and their potential hazard to the City.

Major Streams

The West Fork of the Trinity River is conveyed from northwest to southeast through the center of the City. All other streams in Fort Worth are tributaries of the West Fork of the Trinity River. Some of the major tributaries are the Clear Fork of the Trinity River, Village Creek, Sycamore Creek, Mary's Creek, Big Bear Creek, and Big Fossil Creek. A complete list of streams can be found in the FEMA FIS for Tarrant County which is included on the CD in Appendix F.

Flood Insurance Rate Maps

The first reference for known flood hazards is the Special Flood Hazard Areas (SFHA) as identified by the FEMA FIRM. The SFHA shows the potential extents of the flood during a 100-year and 500-year storm event. Exhibit 3 in Appendix A shows the 100-year and 500-year FEMA floodplains within the Fort Worth city limits. Depths of flooding and velocities within the channel can be found in the FEMA FIS, and warning times vary for riverine flooding.

Structures in the Floodplain

The 100-year FEMA floodplain covers almost 50 square miles of land within the 350 square mile City. This area relates approximately 14% of the City within the 100-year FEMA floodplain. The 500-year flood covers approximately 73 square miles, about 21% of Fort Worth's land area. FNI performed a GIS analysis of the existing structures within the SFHA. Planimetric data representing building footprints was intersected with the 1% SFHA (100-year floodplain) to identify the current number of buildings within the floodplain. Pre-FIRM or Post-FIRM refers to buildings constructed before 1980 or after 1980, respectively. Building age was identified by cross referencing to parcel information from the Tarrant Appraisal District, but was not available for all properties. Table 7 summarizes the specific data concerning buildings located within the 100-year FEMA floodplain.

Table 7: Summary of Structures within the 100 Year FEMA Floodplain

Type of Building	Total	Pre-FIRM	Post-FIRM
All Buildings	5693	4086	1607
Single Family Homes	3615	2725	890
Mobile Homes	258	144	114
Multi-Family Buildings	722	461	261
Non-Residential Buildings	1098	756	342

Open Channel Studies

An additional reference for identifying riverine flooding hazard includes the 15 open channel studies the City has completed and the 18 open channel studies in progress. The name of each open channel study and a brief description for each completed and ongoing study can be found in Appendix C, Tables C-3 and C-4, respectively. Water surface elevations and velocities along each studied reach can be found in each of the studies available at the City. These studies were conducted to identify not only the existing conditions floodplains, but also floodplains assuming fully developed land use conditions and to develop a list of CIP needs for the City. Six of these studies included are completely or mostly located outside of the FEMA FIRM 100-year floodplain. Riverine flooding can occur due to flash floods, which leaves minimal warning times for nearby residents or people at risk within the mapped and unmapped floodplain areas. A further discussion on the City's warning system is included in this section starting on page 18.

Riverine Flooding caused by Reservoir Releases

Riverine flooding can also be impacted by releases from lakes upstream from Fort Worth. Eagle Mountain Lake and Benbrook Lake are controlled reservoirs, and Lake Worth is uncontrolled. Water released from the controlled lakes can cause flooding along the receiving streams even during dry weather. Depths and velocities vary based on the amount of water released. The controlled lakes allow warning times up to 24 hours in advance to warn residents based on water release projections.

Properties surrounding and downstream of Lake Worth are subject to flooding with possibly less warning time than the other two lakes because it is uncontrolled. The uncontrolled release rates also limit the ability of the City to minimize impacts downstream. Release rates from other upstream lakes such as Eagle Mountain Lake and Bridgeport Lake will also affect the flooding depths and flow rates of Lake Worth. Lake Worth shows approximately 290 homes located within the 100-year FEMA flood pool. The depth of flooding surrounding Lake Wake Worth ranges from 1-6 feet. Velocities are assumed to be relatively low as rising water is controlled by the spillway elevation and release rates from the lake. Warning times for

high water at Lake Worth vary based on lake levels, storm intensity and volume of runoff. If the lake is full, then the City can warn residents of potential spillway overtopping at future events, but flash flooding may create minimal warning times.

Repetitive Loss Areas

RLAs also assist the City in identifying known flood hazards inside and outside of the existing FEMA floodplains. Within the city limits of Fort Worth, there are 44 repetitive loss properties, including six severe repetitive loss properties. A Repetitive Loss Property is any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling ten-year period, since 1978. A severe repetitive loss property is a property that received four or more claim payments of at least $5,000 or has received two or more claim payments where the total of the payments exceeds the total property value. There are 26 RLAs identified in the City of Fort Worth. A RLA is a portion of a community that includes repetitive loss properties and nearby properties that may be subject to similar flooding conditions. Each of these areas has at least one repetitive loss property. Two of the RLAs have been mitigated with infrastructure improvements. Exhibit 3 in Appendix B shows the locations of the repetitive loss properties and areas. Table 8 shows data relating RLAs to the 100-year floodplain.

Table 8: Repetitive Loss Area Summary

Repetitive Loss Properties (RLP)	44
RLP in 100-year floodplain	11
Severe Repetitive Loss Properties	6
Mitigated Repetitive Loss Properties	2
Repetitive Loss Areas (RLA)	26
Number of RLA in 100-year floodplain	14
Number of buildings in RLA	1081
Number of buildings in RLA and 100-year floodplain	772
Number of buildings in RLA but not 100-year floodplain	309

The statistics in Table 8 show that 75% (33 of 44) of the repetitive loss properties and 46% (12 of 26) of RLAs are outside of the 100-year floodplain. Theoretically, this means that a large portion of the flooding hazard is due to inadequate storm drain infrastructure, including undersized systems and small channels.

Two of the severe repetitive loss properties are in the Lake Worth 100-year flood pool; however, based on City input, these homes likely flood due to local drainage issues rather than the rising lake levels. The other four properties are located outside of the 100 year floodplain with three homes adjacent to each other in the vicinity of Texas Christian University and one home near Edgecliff Village. The location of

these properties outside of the floodplain is further evidence of inadequate storm drain infrastructure creating flood hazard.

A Repetitive Loss Area Analysis (RLAA) is currently under development as of August 2015 for each RLA identified in the City. This analysis activity is scheduled to be completed by the end of 2015 and will provide the City with more detailed mitigation actions for each particular area.

Drainage Complaints and Storm Drain Studies

The City maintains a drainage complaint database (Storm Events GIS layer) and has both completed and on-going stormwater infrastructure and channel studies to identify known flood hazards. Residents report drainage complaints due to storm events using the stormwater assistance phone number available on the Stormwater Management webpage. The City keeps a record of these complaints within the "storm events" layer of their GIS data. Out of the recent (2009-2015) drainage complaints reported by police, fire department, and residents, 81% of these are located outside the FEMA floodplain and RLAs, as can be seen in Table 9. Most of these reported complaints include either vehicle damage due to flooding, home/property damage due to flooding, or flood waters overtopping roads. It was reported that several clogged storm drains also resulted in flood hazards during storm events. The locations of each of these reported areas are shown in Exhibit 3.

Table 9: Drainage Complaint Summary (May 2009-May 2015)

Location	Number	Percentage
Inside 100-year Floodplain	105	18%
Inside Repetitive Loss Areas	10	2%
Outside Repetitive Loss Areas and 100-year Floodplain	461	80%
Total	571	100%

The source of flooding for the drainage complaints within the 100-year FEMA floodplain can be assumed to be riverine flooding, and the source for flooding outside the floodplain is assumed to be due to inadequate storm drain infrastructure. The statistics in Table 9 support the earlier observation from Table 8 that the source of many of the City's flooding problems is inadequate storm drain infrastructure outside the FEMA floodplain.

In recent years, the City has conducted 10 storm drain improvement studies in areas that have experienced flooding due to storm drain problems. There are 10 additional studies in progress. The name and a short description of each completed and ongoing study can be found in Appendix C in Tables C-5

and C-6 respectively. These studies are intended to identify the needed improvements to provide flood protection and to prioritize the Capital Improvement Plan.

In addition to the open channel and storm drain improvement studies, the City has completed 142 capital improvement projects related to stormwater between 2006 and 2015. A complete list of these projects with a brief description can be found Table C-7 in Appendix C.

Depths and velocities of flooding based on the drainage complaints in the storm events layer are unknown unless located within a studied area. The existing studies discuss the depths and velocities of flooding and can be found at the City by request. Flash flooding occurs in these areas because the storm drain systems cannot handle heavy rainfall in short time periods. Warning times during these storms is very minimal (less than 5 minutes), depending on rain forecasts.

Flood Warning System

Warning residents prior to a flood hazard is an important part of public safety during a storm event. The City monitors stream stage and precipitation depths at 53 locations near low water crossings. The stream gages trigger flashing warning signs to warn motorists of high water. These warning signs start flashing when triggered by flood waters reaching a pre-determined threshold. When flood waters reach this same threshold, the City is alerted and the public works crews begin deploying barricades at these locations where the roadway is likely to overtop. The locations of each of the Advance Warning System (AWS) gauges can be found in Exhibit 4. The flood warning system also includes five lake level monitors and two weather station sites.

The warning time for riverine flooding hazards can be sufficient in the case of controlled lake releases and depending on lake levels. Fort Worth's stream and lake monitors provide detailed information to know when to warn residents. However, there is little to no warning time of flash flooding along creeks and in the areas with inadequate storm drain infrastructure.

An extensive Flood Warning System Study was conducted in 2014 by AECOM for the City of Fort Worth. For further detail about the Fort Worth Flood warning system, see "Flood Warning System Study" on the CD in Appendix F.

LESS-FREQUENT FLOOD HAZARDS

Inventory of Levees

Fort Worth has 22.1 miles of levees. The levees are designed to protect the city against a 500-year flood event. All of the levees in Fort Worth have gravity outlets with no pump stations. Most of the levees are located along the West Fork and Clear Fork of the Trinity River in the west and central areas of the City within the Fort Worth Floodway. The Fort Worth Floodway is a federal project designation approved by Congress in 1945. This project in conjunction with Benbrook Reservoir was designed to provide the leveed areas of Fort Worth with reliable protection against high water levels in the West and Clear Forks of the Trinity River. The project involved channel improvements, construction and strengthening of levees, road relocations, sodding and seeding embankments, installation and modification of drainage structures, and modification of highway and railway bridges. The Fort Worth Floodway project was constructed between 1950 and 1970. There is also a section of levees along the Clear Fork of the Trinity River in the southwest area of the City. The locations of all the levees and dams in the City can be seen in Exhibit 5 in Appendix A. The areas of the City protected by levees are also shown in Exhibit 6. The levees are maintained by the Tarrant Regional Water District. Specific procedures for the operation and maintenance of the Fort Worth Floodway System is included in the *Fort Worth Floodway Operations and Maintenance Manual* found in the CD in Appendix F.

According to Fort Worth's Hazard Mitigation Action Plan a levee failure occurred in 1949 near 12th Street that exacerbated the effects of a flood on the Clear Fork of the Trinity River and had backed up the channel of the West Fork. It is very unlikely that the City will experience another levee failure based on the routine maintenance the levees receive by Tarrant Regional Water District. However, if there were a levee failure in the future, Table 10 shows the area in acres and number of buildings potentially affected and the names of specific areas most prone to damage. It also shows areas that would be susceptible to flood risk if the levees were not in place, or areas at risk of flooding if Fort Worth experiences a storm that exceeded the design criteria for the levees.

Table 10: Areas and Buildings Protected by Levees

Levee	Areas Protected	Area (Ac)	Residential Buildings	Non-Residential Buildings
West Fork 1	Streets to the west of Meandering Road and north of TX 183	87	231	0
West Fork 2	Burton Hills Skyacres/Pecan Drive	567	496	2
West Fork 3	Riverbend Neighborhood	18	17	0
West Fork 4	Streets to the east of Isbell Road and north of White Settlement Road	259	847	9
West Fork 5	Crestwood Neighborhood	140	239	0
WF/CF Confluence	Montgomery Plaza 7th Street, between University Dr. and Clear Fork White Settlement Road between University Dr. and Clear Fork	591	188	297
West Fork 6	Main Street, between North Side Dr and West Fork	360	22	145
West Fork 7	Greenway Neighborhood Rock Island Neighborhood	493	185	63
Total		2515	2225	516

The areas protected by levees seen in Exhibit 6 were delineated by comparing City of Fort Worth 2-foot contours to the base flood elevations on the upstream end of each levee section. Land use data from NCTCOG was then clipped to these areas to identify residential and non-residential areas. The last step included clipping building footprints to the residential and non-residential areas protected by levees. The building footprints were compared with Bing Maps visual imagery and the insignificant footprints (sheds, garages, docks, etc) were deleted. The total number of building footprints was then counted and recorded in Table 10. It should be noted that this data does not including land or buildings protected by the levee along the Clear Fork of the Trinity River. The land behind this levee appears to be higher than the base flood elevations based on the City contours.

Inventory of Dams

There are 51 dams within the Fort Worth city limits. There are several other dams nearby such as Eagle Mountain Lake, Benbrook Lake, and Lake Bridgeport that would impact areas of Fort Worth if they were breached. Exhibit 5 in Appendix A shows the location of each dam. The City owns and operates eight of these dams listed in Table 11. Detailed information on the dams owned by the City can be found in the "Citywide Dam Safety Assessment" in Appendix F.

Table 11: Dams Owned and Operated by City of Fort Worth

City of Fort Worth Dams	
1	Lake Como Dam
2	Luther Lake Dam
3	Lake Worth Dam
4	Fosdic Lake Dam
5	Willow Creek Lake Dam
6	North Side Drive Dam Number 3
7	French Lake Dam
8	Greenbriar Dam

The other dams not listed in Table 11 are owned by private landowners, private companies, or Tarrant Regional Water District. In 2011, the City conducted a dam safety assessment for seven out of these eight dams. For more detail, please refer to Fort Worth's "Citywide Dam Safety Assessment" on the CD in Appendix F. Dams are also regularly inspected by Stormwater Maintenance Engineering.

The State of Texas has identified 11 dams in Fort Worth as high hazard dams. Completion of inundation studies for all high hazard dams in the county will determine the extent of the hazard. Table 12 shows the 11 high hazard dams and what areas would be most affected should a dam breach occur.

Table 12: High Hazard Dams

Name	Owner	Potentially Affected Areas
Bal Lake Dam	Jearl Walker	• Ridglea Hills Neighborhood
Cement Creek Dam	Tarrant Regional Water District	• Union Pacific and Burlington Northern • Industrial Area between NE 38th • Diamond Hill – Jarvis Neighborhood • Long Avenue Railway underpass
Eagle Mountain Lake Dam	Tarrant Regional Water District	• Homes and businesses around • River Oaks Water Treatment • Lakeland Neighborhood • North Lake Worth Neighborhood • Camp Carter Boy Scout Camp • Riverbend Neighborhood • Rockwood Golf Municipal Course • Crestwood Neighborhood
Echo Lake Dam	Tarrant County	• Morningside Neighborhood • Glencrest Neighborhood • Rolling Hills Neighborhood • Berryhill/Mason Heights Neighborhood
Lake Como Dam	City of Fort Worth	• Como neighborhood • Sunset Heights South Neighborhood • Vickery Blvd. • Union Pacific Railway
Lake Worth Dam	City of Fort Worth	• Camp Carter Boy Scout Camp • River Oaks Water Treatment • Rockwood Golf Municipal Course • Crestwood Neighborhood • Gateway Park
Luther Lake Dam	City of Fort Worth	• Ridglea Hills Neighborhood • River Hollow Neighborhood • Vickery Blvd. • Union Pacific Railway
Marine Creek Dam	Tarrant Regional Water District	• Loop 820 • Sansom Park • Marine Park • Northside Neighborhood • Belmont Terrace Neighborhood
Ridglea Country Club Estates Dam	James Buckley	• Ridglea Country Club Estates
White Lake Dam	Nolan Catholic High School	• White Lake Private School • White Lake Hills Neighborhood • Woodhaven Neighborhood
Willow Creek Lake Dam	City of Fort Worth	• Foster Park Neighborhood • Westcliff West Neighborhood

STEP 5. PROBLEM ASSESSMENT

The hazard assessment identified flooding sources such as riverine overtopping and storm drain deficiencies as a risk to the City. Based on the assessment of SFHA and recent stormwater studies within the City, Fort Worth has a high vulnerability to flooding from these sources. There are also dams and levees within the City that could be a potential risk if either were to fail. There has never been a recorded dam failure in Fort Worth, and the levees have been significantly strengthened since the breach in 1949; therefore, Fort Worth has a low vulnerability to dam and levee failure.

HAZUS SUMMARY

HAZUS-MH 2.2 Software was used to estimate potential losses from a hypothetical 100-year flood event in Fort Worth. The software was used to determine flood impacts to life safety and public health, critical facilities and infrastructure, the community's economy and major employers, and the number and types of buildings affected.

The first step in the HAZUS analysis was to create a depth grid. This was done by creating a 10-foot digital elevation model (DEM) from LIDAR data. This was a base surface for the City. The base flood elevations (BFE) from the FEMA floodplain layer were compared to the DEM to determine water surface elevations (WSEL) for a 100-year flood. Raster datasets were created to represent the ground and the WSELs. The ground was then subtracted from the WSELs in order to obtain the depth grid.

HAZUS has a comprehensive set of stock data with location and cost estimation formulas for buildings, utility infrastructure, transportation infrastructure, etc. However, HAZUS analysis is more accurate if local data is added to the stock data. A list of critical facilities was added using the Comprehensive Data Management System (CDMS) tool distributed by FEMA to update information in HAZUS. Tables from the stock data were extracted, then the local data was manipulated to be in the same format as the stock data. The local data was then uploaded into HAZUS. Table 13 shows a summary of the local input that was affected during the HAZUS flood analysis. Exhibit 7 in Appendix A also shows a summary of the input.

Table 13: Summary of Local Data Input into HAZUS

Category	Dataset	Records Affected
Utility Systems	Waste Water Facilities	8
Transportation Systems	Railway Facilities	1
Transportation Systems	Bus Facilities	1
Transportation Systems	Airport Facilities	1
High Potential Loss Facilities	Military	3
Essential Facilities	School Facilities	91
Essential Facilities	Police Station Facilities	19
Essential Facilities	Medical Care Facilities	14
Essential Facilities	Fire Station Facilities	12
Essential Facilities	Emergency Operations Centers Facilities	24

After adding the local data, HAZUS was executed and the results were analyzed. Much of the data in this problem assessment came from a HAZUS analysis, including Tables 13, 14, and 16. It is important to realize that HAZUS evaluates data by census block and tract. Some of these blocks and tracts overlap into neighboring communities. This explains why some of the following tables include buildings outside of the Fort Worth city limits. The data from HAZUS should be viewed as high-level estimates. The data in Tables 13, 14, and 16 are estimates calculated by generalized HAZUS algorithms for each type of building. Several years of data collection concerning what items are kept in each building as well as the building materials would be necessary for a more accurate estimate.

LIFE SAFETY AND PUBLIC HEALTH

Flood hazards can have an impact on life safety and public health. Life safety is of primary concern to the City when determining flood risk. Roadway overtopping from creek crossings as well as roadway flooding can create hazards for drivers and potential loss of life if caught in deep water or shallow water with high velocities. Rising water from streams and storm drains can also create dangerous situations for the population. Public outreach and education of the dangers of high water as well as effective warning systems are paramount to protecting individuals.

Based on the HAZUS analysis, Table 14 shows an estimate of how many people would be displaced from homes and, of those people, how many would seek shelter from public facilities. It is likely that a portion

of those displaced would have family or friends they could stay with, which is why the two numbers in Table 14 do not match.

Table 14: Shelter Needs

Number of Displaced People	26,382
Number of People Needing Short Term Shelter	21,186

Flooded areas and buildings can also create a risk to public health including mold that can form when buildings remain damp for an extended period of time. Black mold can especially create health hazards sometimes leading to hospitalization. Wet areas can also attract unwanted wildlife, such as snakes, that can be potentially harmful to humans. This is why it is important that the City provide shelter for displaced residents. Residents should have access to shelter so they do not have to stay in their flooded property. According to the estimate in Table 13, the City should be prepared to shelter about 22,000 people if a 100-year flood event should occur throughout the City. In 2005, during Hurricanes Katrina and Rita, Fort Worth processed approximately 35,000 people over a six week period to temporary shelters and apartment complexes. The City aims to shelter approximately 3,000-4,000 people in designated facilities at any given time and move them to temporary homes as soon as possible. If a large storm event occurred in Fort Worth, the Emergency Management Office (EMO) and the City would coordinate with neighboring communities to shelter displaced as well.

CRITICAL FACILITIES AND INFRASTRUCTURE

The City developed an inventory of its critical facilities as part of their Hazard Mitigation Action Plan. Critical facilities include fire stations, police stations, medical buildings, schools, and other important buildings. A full list of these facilities is included on the CD in Appendix F. These facilities were analyzed along with the facilities identified with the general building stock from HAZUS to determine if they are vulnerable to flooding and the potential damage that may be expected should a 100-year flood occur.

HAZUS predicts that 22 critical facilities would be affected by a 100-year flood event. However, upon further inspection with GIS and aerial imagery, the list was narrowed down to the 11 facilities shown in Table 15. Some of the facilities removed from the list were somewhat close to the floodplain, so HAZUS most likely considered them damaged because the floodplain enters the same parcel as the building. Other buildings were removed from the list simply because they were geocoded incorrectly in the HAZUS stock data. One other building which was removed from the list was a duplicate of the Fort Worth Police Training Division. Table 15 shows the type of facility, the predicted percent building, and content damage as well as a prediction of days before the facility would be 100% functional again. HAZUS assumes that

when the flood depth of a building reaches half a foot, the building must be evacuated and rendered non-functional. The building damage, content damage, and days before 100% functionality are determined as a function of the flooding depth. This data could be used by the City to make emergency plans regarding where displaced students could attend school while waiting for their own school to be renovated or reconstructed. This information could also be used similarly to make contingency plans for the other damaged facilities.

Table 15: Affected Critical Facilities

Name	Building Type	Functional	Building Damage	Content Damage	Days before 100% Functional
Seminary Hills Park Elementary	School	No	9.28%	65.11%	630
Woodway Elementary	School	No	8.99%	52.89%	480
Dunbar Middle	School	No	5.49%	29.72%	480
East Fort Worth Montessori Academy	School	No	6.71%	36.38%	480
Metro Opportunity	School	No	9.47%	65.88%	630
The White Lake School	School	Yes	1.14%	6.17%	480
Treetops School International	School	No	7.68%	43.14%	480
Cowtown Coliseum	Emergency Center	No	33.02%	100%	720
North Tarrant County Fire Department	Fire Station	No	10.94%	36.94%	480
Fort Worth Fire Station 20	Fire Station	No	6.81%	7.78%	480
Fort Worth Police Training Division	Police	No	11.80%	51.54%	480

Possible damage to roads leading to critical facilities are also of concern. Limited access to hospitals, fire stations and police stations can potentially be life threatening. Mold and other damage resulting from flooding can also impact these facilities financially and close them for extended periods of time placing a larger burden on other nearby facilities.

Damage to utilities, including electrical, potable water, and sewer could displace residents and create a financial burden on the City to repair the damaged facilities. Losing electrical power and water during the summer months could also increase the possibility of heat related illnesses for the elderly and infants.

COMMUNITY ECONOMY AND MAJOR EMPLOYERS

After matching employers from NCTCOG data to the 100-year floodplain, 10 employers were found to be located within the floodplain. Only five out of these 10 employers are insured. Table 16 summarizes information concerning each of these employers, including how many employees work there. The names of these companies will remain anonymous in this report for privacy reasons.

Table 16: Major Employers in the 100-year Floodplain

Sector	Employers	Employees
Manufacturing	3	352
Wholesale Trade	1	229
Retail Trade	1	240
Transportation/Warehousing	1	400
Professional/Scientific/Technical	1	100
Administrative/Waste Management	2	449
Accommodation/Food	1	127
Total	**10**	**1,897**

Based on Table 16, if a 100-year flood event occurred, about 1,900 people would be unemployed. This number would most likely be higher because this is only counting some of the larger employers, while several other small companies could be impacted too.

The HAZUS program has the ability to estimate the total economic loss for different flooding scenarios. HAZUS breaks down the results into two categories: direct building losses and business interruption losses. According to HAZUS, the direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents, and the building interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Table 17 shows the estimated losses for the buildings of Fort Worth due to both building damage and interruption of business. Exhibit 8 in Appendix A shows estimated economic losses in different regions of Fort Worth.

Table 17: Financial Building Losses

	Residential	Commercial	Industrial	Others	Total
Building Loss					
Building	$532,250,000	$127,820,000	$59,370,000	$12,060,000	$731,500,000
Content	$345,160,000	$295,130,000	$140,590,000	$43,120,000	$824,000,000
Inventory	$0	$8,220,000	$19,970,000	$300,000	$28,490,000
Subtotal	$877,410,000	$431,170,000	$219,930,000	$55,470,000	$1,583,980,000
Business Interruption					
Income	$20,000	$1,220,000	$10,000	$50,000	$1,300,000
Relocation	$650,000	$280,000	$10,000	$30,000	$970,000
Rental Income	$160,000	$190,000	$0	$10,000	$360,000
Wage	$50,000	$1,270,000	$10,000	$1,470,000	$2,810,000
Subtotal	$890,000	$2,970,000	$20,000	$1,570,000	$5,440,000
Total	**$878,300,000**	**$434,140,000**	**$219,950,000**	**$57,040,000**	**$1,589,420,000**

Although the HAZUS model is a high-level estimate, it can be concluded that there could be well over $1 billion in damage should a 100-year flood event occur. This is assuming that 100-year flood conditions were affecting the entire City at the same time. Since Fort Worth has a large land area, it is not likely the entire City would simultaneously experience 100-year flood conditions.

HISTORICAL DAMAGE TO BUILDINGS

The NFIP started in 1978, and Fort Worth joined the program in 1980. Since then, there has been at least one paid flood insurance claim in Fort Worth every year except for 1984 and 2011. Figure 2 shows the number of flood insurance claims (paid and unpaid) in each year since 1978. This includes both paid and unpaid claims. Figure 3 shows the dollar amount paid out in flood insurance claims in each year since 1978. Table C-8 in Appendix C is a detailed table of the data in Figures 2 and 3.

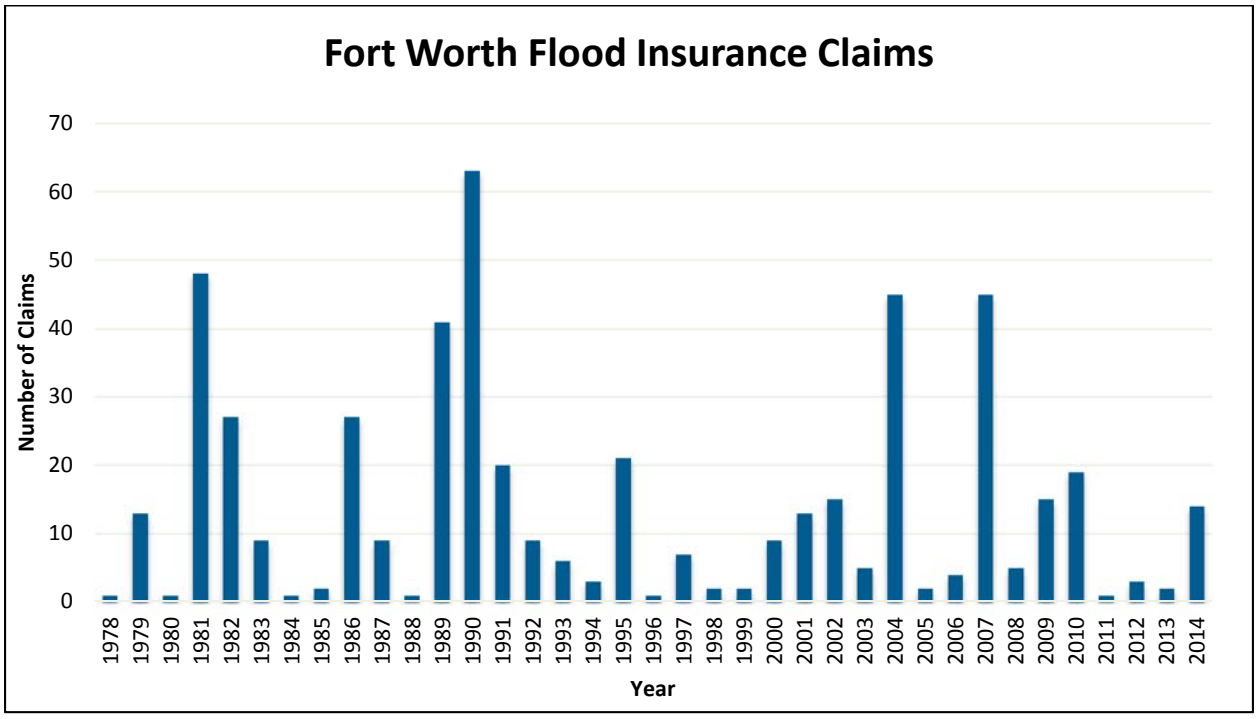


Figure 2: Fort Worth Flood Insurance Claim History

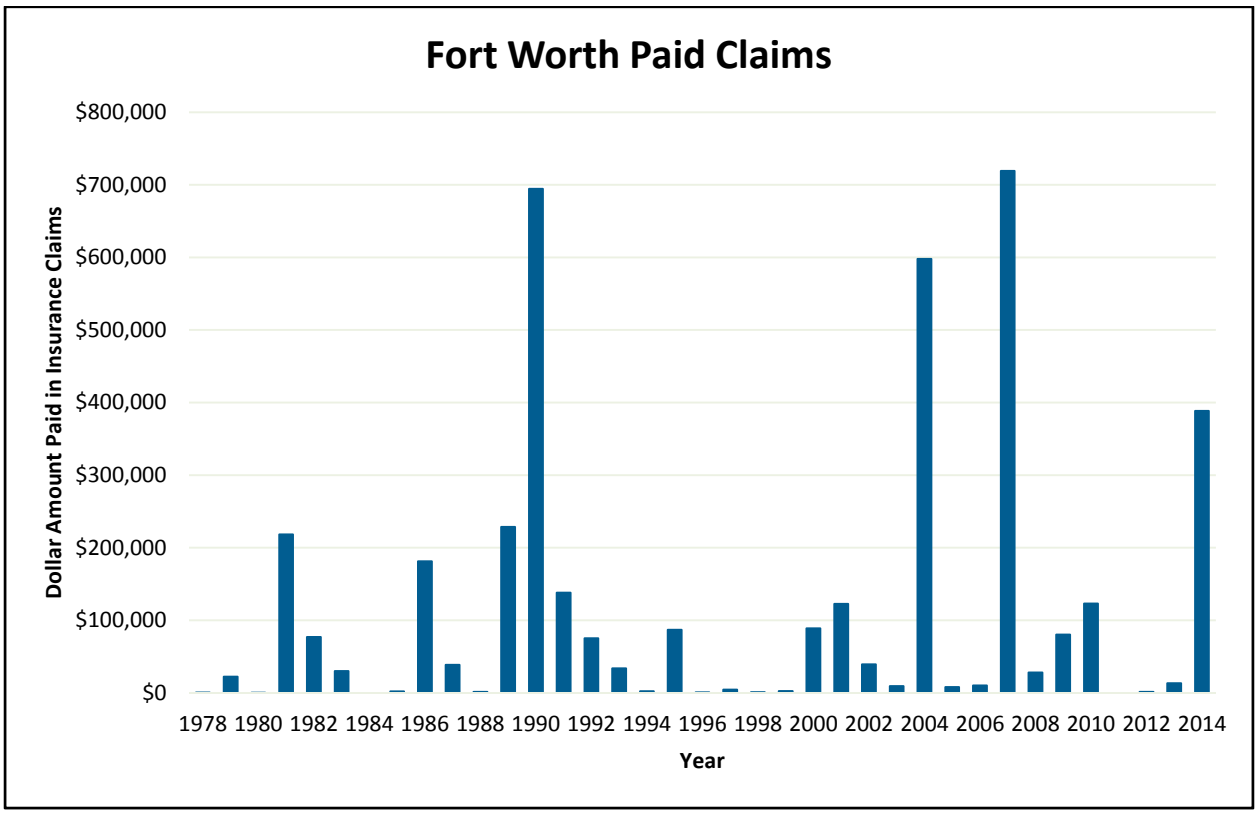


Figure 3: Fort Worth Paid Insurance Claims

As of June 2015, there are 2,411 active flood insurance policies in Fort Worth. Most of these are policies for single family homes. Table 18 shows how many paid claims since 1978 and the dollar amount paid for different types of buildings.

Table 18: Insurance Information by Type of Building

	Policies	Paid Claims	Paid Losses
Single Family	1,942	304	$3,215,674
2-4 Family	31	41	$324,451
Other Residential	182	5	$18,638
Non Residential	256	36	$516,519
Total	2,411	386	$4,075,282

As mentioned before, the City joined the NFIP in 1980. Pre-FIRM refers to buildings constructed in or before 1980. Table 19 shows that most paid claims have been on Pre-FIRM structures, which means that the Fort Worth's ordinances and policies concerning building in the floodplain have been effective.

Table 19: Pre-FIRM/Post-FIRM Insurance Data

	Paid Claims	Paid Losses
Pre-FIRM	323	$3,414,216
Post-FIRM	38	$553,400

More than half of the paid insurance claims have been on properties outside of the 100-year floodplain as can be seen in Table 20. The data from Table 20 came from a GIS file. It varies slightly from the data above in Figure 2 and Tables 17 and 18 because it counts the properties that have received claims, not the number of claims. Regardless, Table 20 is further evidence that inadequate storm drain infrastructure is a larger issue than riverine flooding in Fort Worth. The location of each policy and claim can be seen in Exhibit 9 in Appendix A.

Table 20: Location of Insurance Claims

Fort Worth Flood Insurance Claims (1978-2015)		
Within 100-year Floodplain	116	34%
Outside Floodplain	221	66%
Within Repetitive Loss Areas	58	17%
RLA and 100-year Floodplain	23	7%
Outside Floodplain and RLA	186	55%
Total Number of Properties that have Received Claim Payments	337	100%

There are 2,288 active insurance policies currently in Fort Worth. Using this information, and the data above in Tables 7 and 8, an estimation of insured buildings in the 100-year floodplain and RLAs can be found in Tables 21 and 22 respectively.

Table 21: Insurance Policies in the 100-year Floodplain

	Insured		Uninsured		Total
All buildings	986	17%	4707	83%	5693
Single Family	715	20%	2900	80%	3615
Mobile Home	1	0%	257	100%	258
Multi-Family	105	15%	617	85%	722
Non-Residential	165	15%	933	85%	1098

Table 22: Insurance Policies in Repetitive Loss Areas

	Total	Insured	
Buildings In RLA	1081	199	18%

Flood insurance policies were also compared to properties within the floodplain to determine the value of insured and uninsured property within the floodplain. Building improvement values from the Tarrant Appraisal District were used to develop the total property value at risk. The results are shown in Table 23.

Table 23: Property at Risk in the Floodplain by Dollar Value

	Residential	Non-Residential	Total
Insured	$228 Million	$112 Million	$340 Million
Uninsured	$695 Million	$456 Million	$1.15 Billion
Total	$923 Million	$568 Million	$1.5 Billion

Tables 20 and 21 show there are many people at risk for flooding that do not have insurance. There are also 909 properties with flood insurance policies that are not located within the repetitive loss areas or the 100-year floodplain. This could be because these property owners have experienced flooding caused by inadequate storm drain systems.

City owned buildings within the floodplain were also reviewed. There are 63 buildings in the 100-year floodplain, not including foreclosed homes, where the property ownership is recorded as City of Fort Worth. Of these, only 35 have current flood insurance policies. However, it is not clear without further investigation whether the remaining are actually insurable structures as several were located within parks and could be concession facilities or restrooms. It is also not clear whether they are all owned by the City. In some cases the land could be owned by the City but under a lease to the building owner. Finally, the

policy information does not have a policy holder name. In general, the City is considered to be self-insured, and may not hold insurance policies on structures. In light of this analysis, it is recommended to perform a detailed review on flood insurance for City-owned properties.

STEP 6. GOALS

By implementing the actions within the FMP, the City seeks to reduce and avoid long-term vulnerabilities of identified flood hazards within the City. Developing specific goals for the plan provides future context for review of all floodplain management plans and preserves consistency with other non-flood related community goals, such as the 2015 City Hazard Mitigation Action Plan (HazMAP). The Stakeholder Planning Group reviewed the City's goals as identified in the City of Fort Worth Comprehensive Plan. These goals are stated as follows:

1. Make Fort Worth the nation's safest major city.
2. Improve mobility and air quality.
3. Create and maintain a clean, attractive city.
4. Strengthen the economic base, develop the future workforce, and create quality job opportunities.
5. Promote orderly and sustainable development.

These goals were set after reviewing the Stakeholder Planning Group developed goals for the FMP and identified linkages to the overall City goals. Table 25 summarizes the FMP goals.

Table 24: FMP Goals

FMP Goals		Linkages to City Goals
1.	Protect the health and safety of the public	Links to City goal 1, 5
2.	Facilitate sustainable growth	Links to City goals 4, 5
3.	Educate the public about flood risk, mitigation, and safety in Fort Worth	Links to City goal 1
4.	Reduce the adverse effects of flood events	Links to City goals 1, 2, 3, 4, 5
5.	Develop mitigation actions to address potential regulatory issues and provide regional solutions to flood issues	Links to City goals 5

The Stakeholder Planning Group also reviewed the mission and vision of the Stormwater Management Division, as it is the primary department within the City responsible for flood risk reduction.

Mission: To protect people and property from harmful stormwater runoff.

Vision: To be commonly recognized as an exceptionally effective and progressive municipal stormwater management program.

All of the FMP goals were found to be in line with City and department goals and were finalized with the Stakeholder Planning Group. The mitigation strategies discussed in the following sections were crafted to achieve these goals.

STEP 7. POSSIBLE ACTIVITIES

There are multiple methods to provide mitigation for flooding. Some may be more effective or feasible based on a number of factors such as cost, impact to life safety, etc. This section evaluates the possible activities to determine if they are appropriate actions for the City. These activities are listed below and evaluated in more detail:

1. Preventative activities
2. Property protection
3. Natural Resource Protection
4. Emergency services
5. Structural projects
6. Public information

These activities were discussed with the Stakeholder Planning Group and also presented to the public for input and comments on preference of types of activities at the first public meeting. The survey was described in Step 2 and included in the Appendix. Those comments and survey results were included in the considerations of each type of activity. The City of Fort Worth Stormwater Division met together on August 17, 2015 and discussed what mitigation activities are currently being implemented and what mitigation activities could potentially be implemented in the future. A full list of these mitigation activities is shown in Table C-9 in appendix C. These actions assisted in shaping Steps 7 and 8 of the planning process.

PREVENTATIVE ACTIVITIES

Preventative activities generally include the regulation of development through planning and land acquisition. Table 25 lists a summary of existing ordinances and regulations that the City has adopted to prevent flooding within the floodplain.

Table 25: Existing Floodplain and Stormwater Ordinances and Regulations

Regulation or Ordinance Name
Floodplain Provisions Ordinance
Zoning Ordinance
Comprehensive Plan
International Building Codes
Integrated Stormwater Management Criteria Manual
Grading Ordinance
Subdivision Ordinance

The current floodplain regulations include higher standards than the minimum required NFIP regulations. These regulations are listed in the Zoning Ordinance, Floodplain Provisions Ordinance, and in the International Building Codes. For instance, Chapter 7, Division 4, § 7-350 of the Fort Worth Code of Ordinances states that developing in floodplain designated areas is prohibited unless a technical evaluation completed by a licensed professional engineer shows that there is no increase in flood levels as a result of the development. Section 3.7 of the Local Provisions of the Floodplain Provisions Ordinance also states that the minimum finished floor elevation for lots is 2-feet above the 100-year ultimate water surface elevation. This section also stipulates easement dedication for the ultimate 100-year floodplain and for natural creeks.

The integrated Storm Water Management (iSWM) Criteria Manual for Site Development and Construction provides guidance for development and capital improvement projects relating to stormwater impacts. The manual stipulates that any new or substantial construction for redevelopment must meet current criteria and that the development cannot cause adverse impacts downstream of the site. In other words, the developer must show that the proposed site does not increase discharges. If a site does cause increases in discharges, the developer must show that either the downstream infrastructure has capacity to accept the increase or that they provided detention to existing discharges. The iSWM Criteria Manual

also lists requirements for capital and development projects so that new infrastructure is built to a 100-year fully developed discharge.

The City's floodplain regulations have reduced flood hazards within the City, as evidenced by the claim reduction since NFIP participation in 1980, summarized in Table 26. Many of the claims are also located outside of the FEMA floodplain, as discussed in Steps 4 and 5.

Table 26: Pre- vs. Post- Insurance Claims

	Pre-FIRM (1978)	Post-FIRM (2015)	Total Percent Reduction in Claims
Number of Claims	321	38	88%
Cost of Damages	$3,365,846	$533,400	84%

The City also participates in the Corridor Development Certificate (CDC) program in an effort to protect and reduce flood potential along the Trinity River. In the mid-1980s, the population in the Dallas/Fort Worth area started increasing rapidly. A steering committee and a task force were formed by the cities and counties in the Trinity River Corridor in order to regulate construction in the floodplain. They published the first CDC manual in 1991, and there have been three updated editions since. The purpose of the CDC is to ensure that development in the floodplain in one community would not create runoff that becomes a hazard for a downstream community. The CDC requirements are more stringent than those of the NFIP and requires no loss in valley storage or increase in water surface elevation along the Trinity River. A CDC permit includes review by U.S. Corps of Engineers and the City of Fort Worth prior to approval of construction within the Trinity River Corridor.

Other preventative measures are taken through various departments within the City, including the Planning and Development Department and the Stormwater Department. The Planning and Development Department reviews all permit applications regarding platting and buildings. Any proposed plat is sent through a review process at the City to verify that the plans meet City criteria for floodplain requirements and easements, building codes, and stormwater infrastructure requirements. The Stormwater Department assists in preventative measures, including maintenance activities, to reduce the potential for clogged or ineffective storm drains and channels. Ongoing maintenance programs include the inlet program, dam inspections, maintenance agreement inspections, water quality device inspections and cleaning, and pre- and post-rain event inspections at 300 locations of known hazard areas.

Based on feedback from the first public meeting, residents are interested in preventative measures, including enhancing the maintenance program and creating further regulations for development and

downstream impacts. Current regulations for future development have been effective as indicated by the reduction in claims since NFIP participation and location of claims inside the floodplain versus outside. However, additional measures are warranted for redevelopment in Pre-FIRM neighborhoods and development upstream of older neighborhoods, even outside of the FEMA floodplain. Preventative activities are therefore included in the Mitigation Action Plan. These activities are relatively low in cost, but may require time from City staff for outreach to the Council and public to describe the need for further regulations and explain any new proposed changes.

PROPERTY PROTECTION

Property protection activities involve relocation, acquisition, building elevation, retrofitting, sewer backup protection, and insurance.

The City historically has not been involved in relocation and acquisition projects; however, this activity can be cost effective and is one of few activities that guarantees flood hazard risk reduction. The acquired properties then may be repurposed to open space for different City uses, such as parks, recreation areas, and stormwater detention. Alternatively, the City may provide more public outreach on how an individual property owner can perform activities such as building elevation and retrofit flood proofing and what type of funding is available for a resident to complete the project.

The water department regulates the sewer back up protection and provides 24-hour customer service to remove blockage of the pipe if it is City-owned. Regulations within the City codes also provide protection for sewer backups.

Flood insurance is another method of property protection. While the insurance does not prevent the property from flood damage, it reduces the economic impact on the landowner. The City currently participates in the NFIP with 2,288 insurance policies. The City strongly encourages floodplain insurance participation even if located outside of the FEMA floodplain. This method of flood prevention has been effective in reducing flood damage costs to residents. The cost of flood insurance to the City would just be that of its current buildings within the floodplain. The City would like to improve its communication with the public regarding flood insurance based on conversations with the planning group and public. Currently, there is a citywide mailer intended to enhance insurance awareness and knowledge. Letters are also sent to repetitive loss or frequently flooded areas to encourage insurance participation. As the City continues to improve its CRS score, flood insurance premiums for residents will decrease.

Property protection activities can provide cost-effective benefits from the City. Based on public and City input, mitigation actions were developed for property protection.

NATURAL RESOURCE PROTECTION

There are several areas within the City that are preserved for the purpose of natural resource protection. These areas also provide flood risk reduction when the land is preserved for natural functions because there is less development within the floodplain and less risk for property damage. There are other benefits of natural floodplain functions including improved water quality in the receiving lakes and streams, habitat for wildlife, and recreation opportunities for residents. A primary example of effective natural resource protection in the City is the Fort Worth Nature Center and Refuge (FWNC&R), located adjacent to Lake Worth. The FWNC&R is a 3,000 acre preserve with 20 miles of hiking trails and diverse wildlife including buffalo, alligators, deer, and birds. The FWNC&R includes an area of approximately 1,100 acres of floodplain which is preserved for natural floodplain functions. Other portions of the City that are reserved for natural resource protection include City parks often located within the floodplain. These areas are dedicated open space and not developed.

The City also promotes water quality improvements through their native grass planning program for channel maintenance. They also participate with the NCTCOG and with their native plant program to promote water conservation. Native plants provide benefits in lowering maintenance costs, attracting native wildlife, and improving water quality. Additionally, the City participates in the Reverse Litter Campaign and has a stormwater utility credit program for non-residential development to encourage green infrastructure.

Erosion and sediment control along creeks can help the City to maintain those creeks and reduce potential for property damage along them. The City currently performs geomorphological assessments for highly erosive areas to understand how the channel is operating now and how it might change in the future. Understanding these streams can help the City plan and prevent stream erosion from damaging properties.

The current methods of natural resource protection have been effective in providing the City with flood risk reduction and improving the environment for residents. The City may consider improving on these methods or adding new ones. For instance, establishing other open space areas along floodplains such as buffers and park development that would promote natural resource protections. The public also showed

interest in adding park space and multi-purpose detention facilities during public meetings and through surveys. Mitigation actions related to natural resource protection are included in Step 8 of this FMP as it is not only an effective method for flood risk reduction, but also to integrate multiple community benefits.

EMERGENCY SERVICES

Emergency services are measures that can be taken during a hazard event to minimize the impact to the community. The City has an Emergency Management Office (EMO). The EMO's roles include preparation for natural disasters, mitigation of hazards, and assisting affected residents in recovering from natural disasters. The City Fire and Police Departments are available during a flood event. To assist the department in warning residents when flood hazards occur, the City maintains a Flood Warning System, as summarized in Step 4. The warning system assists the City in knowing when to barricade roads, evacuate homes, and warn residents of possible flood hazards. The City is continually monitoring and updating the flood warning equipment and technology based on the plan in Fort Worth's Flood Warning System Study (2014).

The EMO also monitors the Outdoor Warning System (OWS) and conducts weekly maintenance inspections to assess the system for any failures. The OWS notifies people within the City when severe weather conditions are likely to occur. They signify that people within the community, residents or visitors, should seek shelter. Alerts from the OWS and National Weather Service are also posted on the EMO website (http://fortworthtexas.gov/emo/). The City has multiple community buildings and large arenas for shelter that can be used as temporary shelter for people in severe storms or hazards.

The Fire and Police Departments are on duty for emergency safety response; however, for non-life threatening situations, residents may call the Stormwater Department as they have employees on-call 24 hours per day every day. The Stormwater Department has an Emergency Response Manual that provides detailed guidance for emergency management operations and procedures. This manual is included in Appendix F. Crews are instructed to barricade low water crossings and areas of high water using the High Water Warning System and calls or reports from residents. The High Water Warning System includes over 50 sites within the City. Emergency crews will respond to emergency work orders such as clogged culverts, items fallen into inlets, missing manhole lids, and road cave-ins. The Stormwater Department will also deliver sandbags upon request to properties that are flooding. However, it is the responsibility of every resident to protect his or her property if it may flood. The Stormwater Department also conducts pre- and

post-rain event inspections at 300 locations of known areas with flooding issues, and uses social media and the City website to reach out to the public and warn of severe events.

The need for additional emergency stormwater response, including providing sandbags to residents, was one of the comments the residents brought forward at the public meeting. This shows that many residents may not be aware of the emergency services provided by Fort Worth's Stormwater department. Emergency management operations have been effective in reducing flood risk during events; however, there may be improvements to existing services or additional services the City could provide. Providing emergency services may be funded through the stormwater utility fee, and would have a cost to start the program and annually a cost to maintain it. Mitigation actions are therefore proposed to enhance the City's stormwater emergency services.

STRUCTURAL PROJECTS

Structural projects are intended to redirect water away from an area using infrastructure such as levees, reservoirs, and other flood control measures. The City currently has a Capital Improvement Projects list developed based on stormwater studies that identified locations of flooding. A list of completed projects is included in Appendix C. Projects include regional and local detention, storm drain system improvements, and channel improvements. Areas where structural improvements have been constructed have successfully reduced flood risk in those neighborhoods as evidenced by resident reports and a reduction in insurance claims. The Capital Improvement Projects are funded through the City's Stormwater Utility Fee developed in 2006. Currently, the City is transitioning to a "pay go" program that limits the budget for Capital Improvement Projects to roughly $3.5 million; however, the City has identified over $1 billion in stormwater structural improvement needs. Structural projects may cost more than preventative and protection activities, but in areas where flooding is located outside of the floodplain or in Pre-FIRM or heavily developed areas, structural projects may be the most feasible and publically acceptable. Large multi-jurisdictional regional projects, such as detention along the Trinity River, were discussed among the Stakeholder Planning Group and internally at the City. These types of projects require extensive collaboration and likely outside funds to complete; therefore, they are not included in the final mitigation actions. However, mitigation actions involving structural projects based on the City's Capital Improvement Project list and funding availability are therefore included in Step 8.

PUBLIC INFORMATION

Public education and outreach involves educating property owners and visitors about how to protect themselves and their property from hazards. The City's Stormwater Department has a public information Communications Officer who assists in communicating flood risk materials and information to the public for the Stormwater Management Department. The City currently has numerous methods for distributing information and has multiple public outreach programs through the City and in partnerships with other organizations and communities.

Public Information Distribution Methods

The City currently distributes information to the public mailers, public meetings and events, and through electronic avenues such as the through social media, email, and the City websites. The *Runoff Rundown* newsletter publication is a mailer sent to each property owner through the water bill. The newsletter provides property owners with information regarding flood hazard mitigation, floodplain management, and other activities the City does to protect the public from flood hazards. The publication is sent annually, and an example of the newsletter is included in Appendix B.

Public meetings are held at each Capital Improvement Project and stormwater study to solicit input from residents on flood risk reduction as well as educate about existing flood risks in their communities.

The City website and stormwater website provide many tools and education materials for flood risk education and reduction. For example, residents can learn about upcoming public meetings on the City calendar, learn about flood insurance and current stormwater programs, and they can find who to contact at the City to obtain additional information regarding flooding in a specific area of the City. Links to other hazard mitigation sites are also included on the stormwater management website such as the FEMA hazard mitigation sites and KnoWhat2Do. These resources provide residents with information about flood risks and how to prevent loss of life and property.

Fort Worth uses multiple social media outlets to reach residents, including Facebook, Twitter, "mySidewalk", Nixle, Next Door, and a subscriber email database that includes a weekly City News email and quarterly Eco-Insider email. These outlets are used for two-way communication for the City and the public. The City uses them for public announcements, such as public meetings, as well as during storm events to warn residents of high water and potential flood risks. They are also used to obtain public input on City projects and flooding concerns.

The City also has a Community Engagement Office dedicated to communicating networks of city stakeholders, such as faith-based groups, neighborhood associations, schools and non-profit organizations vital to the success of city initiatives and programs. This office provides another avenue for distributing information throughout the City and encouraging participation in flood risk education activities.

Public Information Activities

The City also participates in public information programs advertised through the outlets described in this section. One example is the "Turn Around, Don't Drown" campaign through the Texas Floodplain Managers Association (TFMA) to warn residents not to drive or walk through areas of high water. Other examples of programs through partnerships with other organizations, departments, and communities dedicated to flood risk reduction are included in Table 27.

Table 27: Public Outreach Programs in Partnership with other Organizations

Partnership Organization	Program	Goal
FEMA	Protect What Matters	Flood Risk Reduction
TRWD	Reverse Litter	Water Quality
TRWD	Adopt an Inlet	Flood Risk Reduction
NCTCOG	Pet Waste Education	Water Quality
NCTCOG	Campaign to prevent lawn waste in storm drains	Water Quality
Fort Worth	Keep Fort Worth Beautiful	Water Quality
TFMA	Turn Around Don't Drown	Flood Risk Education
BRIT	Rain Barrel Sales	Flood Risk Reduction and Water Quality

The Stormwater Department also performs public information activities that are City-sponsored. Flood protection assistance is provided, and data on historical flooding in neighborhoods, flood related data, and other information can be provided by calling the Stormwater Management Department. The City is willing to assist with floodplain development permits, make site visits to review flooding and drainage issues, and provide advice on retrofitting activities. Areas of potential high water are currently shown on the Planning and Zoning website and flood mapping data is also available through the City or FEMA.

The Stormwater Department hosts the Neighborhood University to train neighborhood leaders to promote flood safety and protection. The Stormwater department also participates in other community events led by the engagement office such as the Cowtown Cleanup, Earth Day, Yard Smart, Waterama, and other events such as speaking at school or civil groups. These events are used as a way to educate

residents on the importance of stormwater flood protection, water quality and conservation. Other education oriented outreach programs include a stormwater utility credit for schools that provide flood risk education during the school year. Adopt a creek and adopt an inlet programs also involve residents in improving water quality and flood protection.

The City's Police Department participates and runs a program called the Community Emergency Response Team (CERT). The program's goal is to provide residents with basic skills that they will need to respond to their community's immediate needs in the aftermath of an extreme disaster when emergency services may not be immediately available. Training is free and open to anyone living, working, or has a vested interested in the City.

Insurance policies have increased partly due to public outreach, but there are still many homes within and without of the floodplain at risk and do not have insurance. The City currently has an extensive outreach program, but questions from residents still arise as far as what to do during a flood and what assistance is available to residents. The City has also expressed the need to provide more information to the residents on flooding outside of the floodplain and on obtaining flood insurance policies. Public information is an effective and cost efficient way to prevent loss of life and property during a flood event. Funding for these projects is available through the City and some are inter-departmental. The City, therefore, plans to continue and improve upon its public information activities.

STEP 8. ACTION PLAN

The City and the Stakeholder Planning Group developed 27 mitigation actions as part of the FMP. These action items address all six categories identified in the Activity 510 of the *CRS Manual* and correspond to at least one of the FMP goals listed in Step 6. The mitigation actions are intended to reduce flood risk for existing properties and to protect new construction from the effects of flood hazards. The City plans to continue to perform the activities described in Step 7 as well as improve upon them and add new activities. The mitigation activities are summarized in Table 28 including the priority, cost, funding, timeframe for completion and responsible departments. The goals achieved by each action are also included in the table.

A few of the mitigation actions include acquiring property or designating open space areas through zoning and ordinances. The intended land use for the acquired properties depends on the mitigation action and is stipulated in Table 28 within the action description. These projects will be managed through the

Stormwater Department and shall include public outreach and participation. City-owned property shall be subject to existing ordinances and maintenance agreements.

PRIORITIZATION

Each mitigation action was prioritized based on the same **STAPLE+E** criteria listed in the 2015 HazMAP plan for prioritizing mitigation actions, as listed below:

Social - Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population, do not cause relocation of lower income people, and if they are compatible with the community's social and cultural values.

Technical - Mitigation actions are technically most effective if they provide long term reduction of losses and have minimal secondary adverse impacts.

Administrative - Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding.

Political - Mitigation actions can truly be successful if all stakeholders have been offered an opportunity to participate in the planning process and if there is public support for the action.

Legal - It is critical that the City have the legal authority to implement and enforce a mitigation action.

Economic - Budget constraints can significantly deter the implementation of mitigation actions. Hence, it is important to evaluate whether an action is cost effective, as determined by a cost benefit review, and possible to fund. It is difficult to perform a numerical analysis on the benefit of many of the mitigation actions (such as public outreach), so only a general cost-benefit analysis was completed for each action by considering the funds available, cost of the project, and overall benefit to the City.

Environmental - Sustainable mitigation actions that do not have an adverse effect on the environment, that comply with Federal, State, and local environmental regulations, and that are consistent with the City's environmental goals, have mitigation benefits while being environmentally sound.

Based on the criteria above, actions were assigned a High, Moderate, or Low priority according to the following definitions:

High Priority – Action should be implemented as soon as possible. This action will immediately reduce the risk to life and property. Vulnerability will be reduced. Community and political support is high. Funding is available.

Medium Priority – Action should be implemented in the near future. Lives and property will be protected. Community and political support is high. Funding may be available.

Low Priority – Action should be implemented over the long term. Cost of the project may render it unfeasible. There may be political, historical, or environmental issues.C-9 in appendix C summarizes these actions.

Table 28: Mitigation Action Plan

Summary of Mitigation Actions							FMP Goals				
	Mitigation Action	Priority	Cost Range	Potential Funding Source	Timeframe for Completion from Plan Adoption	Responsible Department	Protect Health & Safety	Facilitate Sustainable Growth	Educate Public	Reduce Adverse Impacts	Regulatory & Regional Solutions
1	**Preventative Activities**										
1.1	**Continue Ongoing Preventative Activities**										
	• Floodplain mapping- FEMA and potential areas of high water • Drainage system maintenance • Vegetation maintenance program • Dam inspections • Maintenance agreement inspections • Bridge inspections • Pre and post rain event inspections on 300 locations (known areas of issues) • Water quality device inspections and cleaning • Maintain a GIS inventory of stormwater assets • Using the potential areas of high water information to make better planning decisions • Development review/iSWM criteria • Inlet marker program • Enhanced floodplain regulations, including dedication of 100-year fully developed floodplain	High	$500K-$1M	SWU	Ongoing	Stormwater	x	x		x	
1.2	**Continue and enhance stormwater maintenance program**										
1.2.a	Add open channel inspections to regular maintenance program	High	<$500K	SWU	0-3 years	Stormwater	x			x	
1.2.b	Include criticality (business risk exposure) information for prioritizing maintenance actions and planning activities	High	<$500K	SWU	0-3 years	Stormwater	x			x	x
1.2.c	Perform a channel inventory including type, condition and include in maintenance program	High	<$500K	SWU	0-5 years	Stormwater	x			x	x
1.2.d	Establish a CCTV program for pipe inspections	High	<$500K	SWU	0-5 years	Stormwater	x		x	x	
1.3	**Expand Floodplain Mapping and Data Availability**										
1.3.a	Add to and improve stormwater inventory and GIS data	High	<$500K	SWU	Ongoing	Stormwater	x		x	x	
1.3.b	Create flood risk overlays for areas outside the FEMA floodplain that are subject to flooding and develop local regulations for these areas	Medium	<$500K	SWU	5-10 years	Stormwater	x		x	x	x
1.3.c	Make flood study models available to the public online	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	
1.3.d	Make flood study mapping available to the public online	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	
1.3.e	Perform Repetitive Loss Area Analysis study for all RLAA (Section 512 of the CRS Manual)	High	<$500K	SWU	1 year	Stormwater	x		x	x	x

	Mitigation Action	Priority	Cost Range	Potential Funding Source	Timeframe for Completion from Plan Adoption	Responsible Department	Protect Health & Safety	Facilitate Sustainable Growth	Educate Public	Reduce Adverse Impacts	Regulatory & Regional Solutions
1	**Preventative Activities, continued**										
1.4	**Continue enforcement of floodplain and stormwater regulations higher than NFIP standards**	High	<$500K	SWU	Ongoing	Stormwater	x	x		x	x
1.4.a	Evaluate and develop city-wide valley storage regulations to reduce future flooding. Consider similar regulations currently in place at other cities (Dallas, Grand Prairie, Arlington, etc.)	Medium	<$500K	SWU	0-5 years	Stormwater	x	x	x	x	x
1.4.b	Evaluate and develop flood risk management & prevention regulations for areas outside FEMA floodplains that utilize best available data.	Medium	<$500K	SWU	0-5 years	Stormwater	x	x	x	x	x
1.4.c	Continue to participate in CDC program	High	<$500K	SWU	Ongoing	Stormwater	X	x	x	x	x
1.5	**Expand Open Space Preservation**										
1.5.a	Coordinate open space opportunities with flood control needs for new developments, repetitive loss areas, and tax foreclosed properties	Medium	<$500K	SWU	5-10 years	Stormwater/P&D/PACS		x		x	
1.6	**Complete Update of the Stormwater Criteria Manual**	High	<$500K	SWU	0-5 years	Stormwater	x	x		x	

	Mitigation Action	Priority	Cost Range	Potential Funding Source	Timeframe for Completion from Plan Adoption	Responsible Department	Protect Health & Safety	Facilitate Sustainable Growth	Educate Public	Reduce Adverse Impacts	Regulatory & Regional Solutions
2	**Property Protection**										
2.1	**Continue Ongoing Property Protection Actions**										
	• Maintenance agreements • Citywide mailer to enhance insurance awareness and knowledge • Letters to Repetitve Loss Areas (RLA) or frequently flooded areas • Sewer back up protection (water department)	High	<$500k	SWU	Ongoing	Stormwater	x	x	x	x	
2.2	**Increase Flood Insurance Participation**										
2.2.a	Provide link to Floodsmart on city website	High	<$500K	SWU	0-3 years	Stormwater			x		
2.2.b	Refine statistics to prioritize which areas to target for insurance outreach	High	<$500K	SWU	0-3 years	Stormwater			x	x	
2.2.c	Hold workshops in prioritized areas to encourage residents to purchase flood insurance	High	<$500K	SWU	0-5 years	Stormwater			x		
2.2.d	Perform a detailed review of flood insurance for City owned properties	High	<$500K	SWU	0-5 years	Stormwater			x	x	
2.3	**Encourage Relocation, Acquisition & Building Elevation Projects**										
2.3.a	Develop a voluntary property acquisition plan and program	High	$500K-$1M	SWU/Grants	0-5 years	Stormwater	x			x	x
2.3.b	Pursue grants to complete property acquisition projects	High	<$500K	SWU/Grants	0-5 years	Stormwater	x			x	
2.3.c	Develop public education on funding for property retrofitting & building elevation	Low	<$500K	SWU	0-10 years	Stormwater			x	x	
2.3.d	Assist property owners with grant applications for improvements	Low	<$500K	SWU/Grants	Ongoing	Stormwater			x	x	
2.3.e	Develop a program to assist property owners with elevation & relocation projects for residential structures	Medium	<$500K	SWU/ICC/FEMA	0-5 years	Stormwater	x			x	

	Mitigation Action	Priority	Cost Range	Potential Funding Source	Timeframe for Completion from Plan Adoption	Responsible Department	Protect Health & Safety	Facilitate Sustainable Growth	Educate Public	Reduce Adverse Impacts	Regulatory & Regional Solutions
3	**Natural Resource Protection**										
3.1	**Continue Ongoing Natural Resource Protection Actions**										
	• Native grass planting program for channel and detention maintenance • Native plant program participate with Water Conservation and NCTCOG • Reverse Litter Program • Stormwater credit program for non-residential • iSWM review for erosion and sediment control • Geomorphological assessments for highly erosive areas	High	<$500k	SWU	Ongoing	Stormwater	x	x	x	x	x
3.2	**Maintain Current Natural Preserved areas**										
3.2.a	Maintain FWNC&R as nature preserve	High	<$500K	PACS	Ongoing/None	PACS		x			
3.2.b	Maintain parks to preserve open space within the floodplain	High	<$500K	PACS	Ongoing/None	PACS		x			
3.2.c	Place "no mow" signs in appropriate locations and establish native grass and other "Green Zones"	Medium	<$500K	SWU/PACS	0-3 years	Stormwater/PACS		x	x		x
3.2.d	Train park staff on maintenance practices that facilitate natural preservation	High	<$500K	SWU/PACS	0-3 years	Stormwater/PACS		x	x		
3.4	**Develop regulations focused on natural area preservation**										
3.4.a	Develop watershed protection plans and ordinances that require floodplain buffers and water quality protection zones such as Lake Worth Watershed Protection project	Low	<$500K	Water	0-10 years	Stormwater/Water		x			x
3.4.b	Provide economic incentives for developers to preserve natural areas	Medium	<$500K	SWU	0-10 years	Stormwater/P&D		x			x
3.4.c	Explore opportunities for tourism/education grants and tie into recreation functions	Low	<$500K	PACS	0-10 years	Stormwater/Parks/TRVA		x			
3.4.e	Dedicate more area to natural preservation by acquiring open space within the floodplain (rather than easement dedication)	Low	$500K-$1M	SWU/PACS	0-10 years	Stormwater		x			x
3.5	**Expand Water Quality Regulations and Education**										
3.5.a	Incorporate Green Infrastructure Practices into development practices as much as practicable to improve water quality	Medium	<$500K	SWU	0-5 years	Stormwater		x			x
3.5.b	Expand existing native grass planting program	Medium	<$500K	SWU	0-5 years	Stormwater		x			x
3.6	**Implement erosion control projects from Geomorphic Assessments**	**Medium**	**<$500K**	**SWU**	**5-10 years**	**Stormwater**	x	x	x	x	x

	Mitigation Action	Priority	Cost Range	Potential Funding Source	Timeframe for Completion from Plan Adoption	Responsible Department	Protect Health & Safety	Facilitate Sustainable Growth	Educate Public	Reduce Adverse Impacts	Regulatory & Regional Solutions
4	**Emergency Services**										
4.1	**Continue Ongoing Emergency Services**										
	• Pre and post rain event inspections on 300 locations (known areas of issues) • Block streets that become flooded- barricade list • Current high water warning system (50+ sites) • Identify flooding level of service for major road crossings • Nixle, twitter, Facebook, City website- social media • Protect critical facilities and flood prone areas from debris by expanding the maintenance program to include trash pick-up (including bulk) prior to forecasted large events	High	<$500k	SWU	Ongoing	Stormwater	x	x	x	x	
4.2	**Expand Flood Warning System**										
4.2.a	Expand Flood Warning System based on recommendations from Fort Worth Flood Warning System Study	Medium	$500K-$1M	SWU	0-5 years	Stormwater/EMO	x		x	x	
4.2.b	Expand subscription based program for text and email severe weather warnings and encourage participation to all residents through workshops and the Runoff Rundown Newsletter	High	<$500K	SWU	Ongoing	Stormwater/EMO	x		x	x	
4.2.c	Expand Social Media program during flood events	Medium	<$500K	SWU	0-5 years	Stormwater/EMO	x		x	x	
4.2.d	Develop online mapping of current road closures, detours, etc. during flood events possibly through Waze through City website	Medium	<$500K	SWU/Grants	0-5 years	Stormwater/EMO	x		x	x	
4.2.e	Expand Collaborative Adaptive Sensing of the Atmosphere (CASA) by Investigating additional radar sites and possibly implement based on findings	Medium	<$500K	SWU	0-5 years	Stormwater/EMO	x		x	x	
4.2.f	Develop program for real time flood forecasting and integrate with CASA radar	Medium	<$500K	SWU	0-5 years	Stormwater/EMO	x		x	x	
4.3	**Improve Hazard Response Operations**										
4.3.a	Expand sandbag program for residents and provide public outreach on when they are available and how they can be obtained	High	<$500K	SWU	0-3 years	Stormwater/EMO	x		x	x	
4.3.b	Investigate grant funding available for emergency services	Medium	<$500K	SWU/Grants	0-5 years	Stormwater/EMO	x		x	x	

	Mitigation Action	Priority	Cost Range	Potential Funding Source	Timeframe for Completion from Plan Adoption	Responsible Department	Protect Health & Safety	Facilitate Sustainable Growth	Educate Public	Reduce Adverse Impacts	Regulatory & Regional Solutions
5	**Structural Projects**										
5.1	**Continue Ongoing Structural Projects**										
	• Low water crossings • Regional stormwater detention with multi-use amenities • Local stormwater detention • Pipe system improvements • Partnership with Ft Worth ISD for regional stormwater detention • TRWD coordination with regional agencies such as TRWD, USACE, NWS, etc. • Incorporate Green Infrastructure in City facilities and projects as feasible • Open channel improvements • Ongoing maintenance • Coordination with other City departments on drainage requirements for City projects • Continue to study flood prone areas and incorporate new studies into current CIP program	High	>$1M	SWU	Ongoing	Stormwater	x	x	x	x	x
5.2	**Reduce flood risk through Storm Drain Capital Improvement Projects**	**High**	**$1M - $2M**	**SWU**	**Annually**	**Stormwater**	x	x		x	x
5.2.a	Increase capacity of existing systems identified through stormwater studies with pipe bursting	Low	<$500K	SWU	Annually	Stormwater	x			x	
5.2.b	Develop a pipe rehabilitation program	Medium	$500K-$1M	SWU	0-5 years	Stormwater	x			x	
5.2.c	Prioritize drainage studies and improvements to maximize flood risk reduction	High	<$500K	SWU	As Needed	Stormwater	x		x	x	x
5.3	**Reduce flood impacts through detention**										
5.3.a	Investigate opportunities to retrofit existing HOA or wet ponds for flood control	Medium	<$500K	SWU	0-5 years	Stormwater	x	x		x	x
5.3.b	Perform study to determine locations ideal for regional detention	Medium	<$500K	SWU	0-5 years	Stormwater	x			x	x
5.3.c	Construct local and regional stormwater detention facilities in flood prone areas	Medium	>$1M	SWU	5-10 years	Stormwater	x			x	x
5.3.d	Evaluate modifications to Lake Worth spillway to allow for more flexible discharge	Low	<$500K	SWU/TRWD/Water	5-10 years	Stormwater	x			x	x
5.3.e	Investigate opportunities to increase valley storage within the Trinity River Floodplain, including regional solutions with regional agencies and adjacent communities	Low	>$1M	SWU/TRWD/USACE	5-10 years	Stormwater	x			x	x
5.4	**Reduce flood risk at hazardous road crossings**										
5.4.a	Develop a plan to upgrade existing low water crossings to improve service levels	Medium	<$500K	SWU	0-10 years	Stormwater	x			x	x
5.4.b	Increase capacity of existing culverts and bridges (1-2 annually) to City criteria	High	<$500K	SWU	Ongoing	Stormwater	x			x	
5.5	**Pursue partnerships to complete stormwater projects**										
5.5.a	Develop collaborative program between the stormwater and parks departments to create opportunities for flood protection and recreation in open spaces	High	<$500K	SWU	0-5 years	Stormwater/Parks	x			x	x

	Mitigation Action	Priority	Cost Range	Potential Funding Source	Timeframe for Completion from Plan Adoption	Responsible Department	Protect Health & Safety	Facilitate Sustainable Growth	Educate Public	Reduce Adverse Impacts	Regulatory & Regional Solutions
5	**Structural Projects, continued**										
5.5.b	Develop collaborative program between the stormwater and water departments to create collaborative program for utility and stormwater upgrades	High	<$500K	SWU	0-5 years	Stormwater/Water	x			x	x
5.5.c	Create a system for development incentives for improving city storm water infrastructure	Medium	<$500K	SWU	0-5 years	Stormwater	x			x	x
5.5.d	Continue to pursue partnerships with FWISD to complete stormwater projects on school sites	Medium	<$500K	SWU	0-5 years	Stormwater	x			x	x
5.5.e	Identify opportunities for public and private partnerships to complete CIPs	Medium	<$500K	SWU	0-5 years	Stormwater	x			x	x

	Mitigation Action	Priority	Cost Range	Potential Funding Source	Timeframe for Completion from Plan Adoption	Responsible Department	Protect Health & Safety	Facilitate Sustainable Growth	Educate Public	Reduce Adverse Impacts	Regulatory & Regional Solutions
6	**Public Information**										
6.1	**Continue Ongoing Public Information Activities**										
	• Making the public aware of areas of potential high water through the planning & zoning website • Stormwater educational materials Curriculum developed with school districts • Yard Smart twice a year (fall and spring) • Inlet marker program and Adopt a Creek programs • School credit program to reduce SW utility fees • West Nile education • Partnership programs: FEMA in Protect What Matters, TRWD in Reverse Litter and adopt an inlet program, COG in campaign to not have lawn companies not blow waste into storm drains and pet waste education, internally partner with office of emergency management on know what to do program (Turn Around Don't Drown), internally with keep Fort Worth Beautiful to promote protecting water quality • Partner with TRWD on Trinity Trash Bash • LIDs- rain barrel sales in partnership with BRIT and with several internal departments (ENV and Water), native plants through COG and Water Department Water Conservation Group and ENV • City website, City news that media can check to mine for stories, opportunistic stories with media to promote SW program, water bill inserts (City Times), twice a year paid water bill insert • Community Engagement Office- direct link to 200+ neighborhood associations- attend meetings and give our message on our behalf, host twice a year Neighborhood University to train neighborhood leaders with our message (flood safety, protection, etc.), outreach at community events- Cowtown cleanup, Earth Day, Yard Smart twice a year, Waterama, and many smaller ones such as speaking at school groups, civic groups, boy scouts, etc. • Social media- use Facebook, twitter, City website, “mySidewalk”, Nixle, Next Door, subscriber email database - once a week City News email blast and quarter Eco Insider email • Hold events to feature specific projects (and share messaging) • Direct mail of newsletter once a year to all water subscribers and rate payers	High	<$500k	SWU	Ongoing	Stormwater	x		x	x	
6.2	**Create targeted outreach programs**										
6.2.a	Target meetings in extreme regions (far north, newly annexed areas, etc.) to share messaging	High	<$500K	SWU	0-5 years	Stormwater	x		x	x	
6.2.b	Direct mail of FEMA flood protection information to targeted areas of high flood risk	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	
6.3	**Provide additional outreach to community regarding flood risk**										
6.3.a	Send Runoff Rundown bi-annually instead of annually	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	

	Mitigation Action	Priority	Cost Range	Potential Funding Source	Timeframe for Completion from Plan Adoption	Responsible Department	Protect Health & Safety	Facilitate Sustainable Growth	Educate Public	Reduce Adverse Impacts	Regulatory & Regional Solutions
6	**Public Information, continued**										
6.3.b	Create Facebook group for stormwater	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	
6.3.c	Participate in Mayfest and Main Street Art Festival with Flood Risk Educational Material	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	
6.3.d	Hold a large community event dedicated to stormwater education annually	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	
6.3.e	Expand use of “mySidewalk” and “Next Door” to solicit input from community	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	
6.3.f	Expand adopt-an-inlet and adopt-a-creek programs	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	
6.3.g	Continue to hold public meetings during stormwater capital improvement projects	High	<$500K	SWU	Ongoing	Stormwater	x		x	x	
6.3.h	Become more active in flood awareness week through additional social media outlets and community events	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	
6.3.i	Move City flood safety awareness week to October to be consistent with TFMA	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	
6.3.j	Hold a contest to design manhole lids and educational signage	Medium	<$500K	SWU	0-5 years	Stormwater	x		x		
6.3.k	Develop paid advertisements through Public Service Announcements to educate the public about flood insurance and flood risk	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	
6.4	**Improve education of flood risk to schools and youth**										
6.4.a	Participate in school events: -Stormwater management projects that tie into Water Quality program -Create a calendar with children’s drawings related to flood risk and water quality -Billboard competition -Continue Waterama: 4th graders, TADD, RDSD -Riverside plan for retrofitting school event in November -Career Days	High	<$500K	SWU	0-5 years	Stormwater	x		x	x	
6.4.b	Expand curriculum to other ISDs in Fort Worth	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	
6.5	**Educate the public about Environmental Protection and Water Quality**										
6.5.a	Install interpretive signage in appropriate areas to discuss natural resource protection, stormwater systems, etc. Add educational signage to regional projects as appropriate	Medium	<$500K	SWU	0-5 years	Stormwater	x	x	x	x	
6.6	**Provide technical assistance to the public on how to interpret flood data**										
6.6.a	Establish policy papers to interpret grey areas or guidance based on experience (Development Review Group function)	Medium	<$500K	SWU	0-5 years	Stormwater	x		x	x	
6.6.b	Hold regularly scheduled sessions to discuss stormwater related topics such as LID, water quality, development review subjects, etc.	Medium	<$500K	SWU	0-5 years	Stormwater	x	x	x	x	
6.6.c	Provide direct link to floodplain management staff through the stormwater website	High	<$500K	SWU	0-5 years	Stormwater	x		x	x	

STEP 9. ADOPTION OF ACTION PLAN

A resolution to adopt the Floodplain Management Plan is to be adopted by Council. This resolution will be included in this document upon adoption. The FMP will be updated at that time.

STEP 10. IMPLEMENTATION, EVALUATION, AND REVISION

MONITORING AND EVALUATING THE PLAN

The FMP is intended to be the primary guide for implementing and prioritizing flood risk reduction mitigation actions in the City. To remain relevant, the plan must first be implemented by the City, evaluated regularly, and revised as changes occur. The Floodplain Administrator will monitor and lead future planning efforts with the Stakeholder Planning Group formed in Step 2 of the plan development. The same group or a successor group with similar membership intends to continue assisting the City with future changes and mitigation planning. The Stakeholder Planning Group will meet once every year prior to October 1 to evaluate the plan progress and effectiveness of current action items. The following items are suggested to be discussed during the meeting:

- Record occurrences of flood hazard events within the City since adoption of the plan.
- Provide an update on any mitigation actions that have been implemented and/or completed.
- Provide suggestions or concerns about their experiences and efforts to implement the action in this plan. These suggestions should be documented and revisited during the City's plan update.
- Make minor adjustments to the plan as additional information becomes available.
- Discuss and assess the plan's overall effectiveness at achieving the goals.

The Floodplain Administrator shall take the comments from the Stakeholder Planning Group meeting to prepare an annual evaluation report on progress towards plan implementation. This report shall be submitted to the City Council, released to the media, and made available to the public through the outlets described in the Step 2 Public Outreach section.

UPDATING THE PLAN

The *CRS Manual* requires that the FMP be formally reviewed and updated every five years prior to October 1 of the fifth year of plan adoption. The Floodplain Administrator will be responsible for preparing the

formal update to the plan. The formal review and update of the plan should be started 12-18 months before the end of the fifth year in order to allow time for public comments and responses to be addressed.

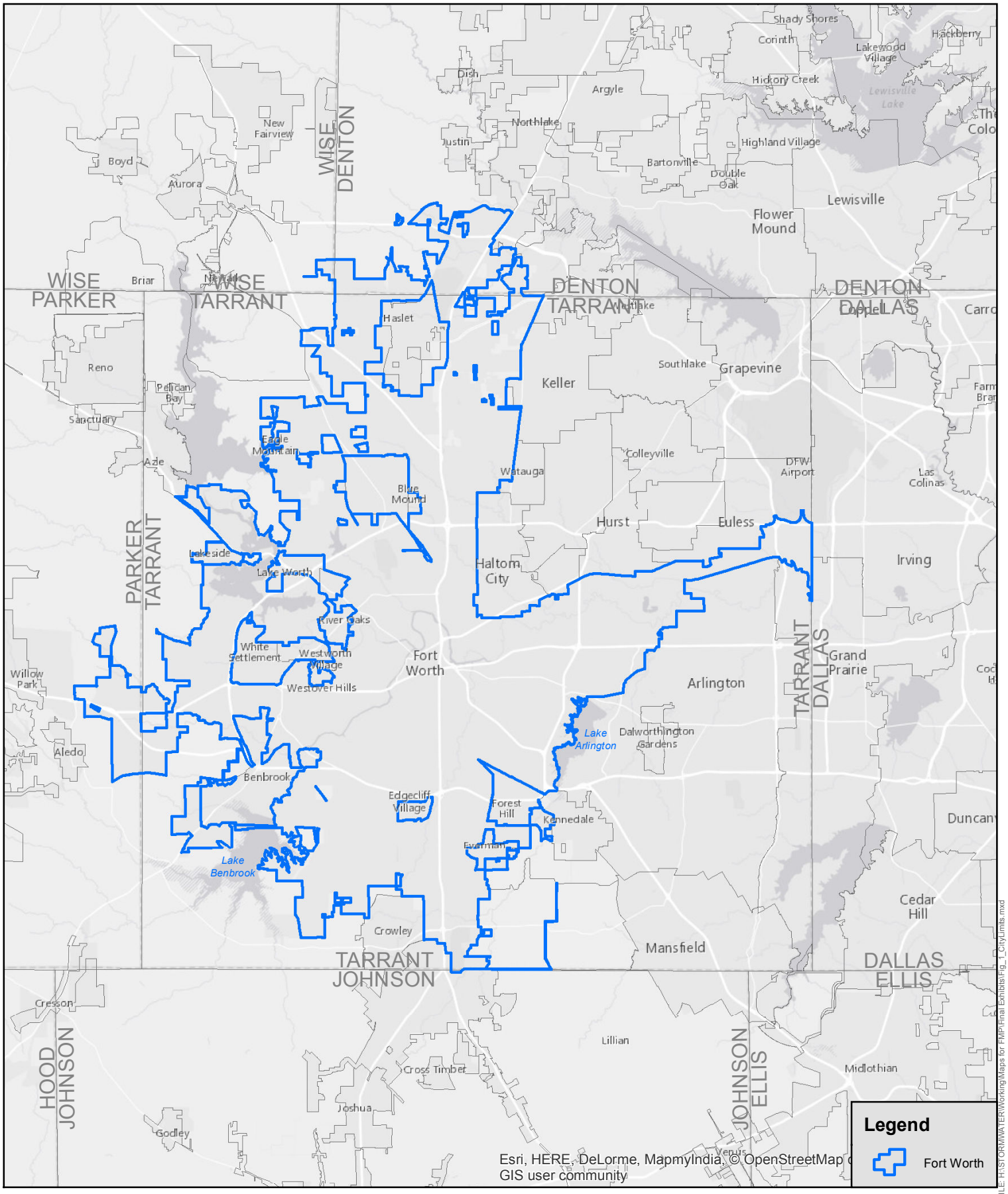
The general process for updating the plan shall be as follows:

1. City Floodplain Administrator begins the process with a meeting with the Stakeholder Planning Group formed in Step 2. This meeting will be similar to the annual meeting to evaluate overall performance and progress of the plan.
2. The City shall review any new studies, reports, and technical information and incorporate into the plan as necessary. The review will also include the City's needs, goals, and plans for the area that have been published since the plan was prepared.
3. The hazard and problem assessment sections shall be reviewed and revised to reflect new data.
4. The Stakeholder Planning Group shall evaluate the FMP goals and determine if they are still appropriate. Revisions will be made accordingly.
5. The City shall revise the action plan based on projects that have been completed, dropped, or changed since the FMP adoption.
6. The City will meet a second time with the Stakeholder Planning Group to finalize revisions and updates to the FMP.
7. The City shall hold a public meeting to discuss the update FMP.
8. The updated plan shall be adopted by City Council.

This process is meant to be a guide, and there may be additions when the plan updates occur. The City will continue to seek public participation through the same outreach methods as the development of the plan by their social media outlets, Runoff Rundown, and City website pages. The Stakeholder Planning Group shall also be involved in reviewing and updating the plan. Any revisions and plan updates shall be formally adopted through a resolution by the City Council.

Appendix A

Exhibits



FREESE AND NICHOLS
4055 International Plaza
Suite 200
Fort Worth, Texas 76109
P: 817-735-7300 F: 817-735-7491
JOB: FT115220
DATE: 9/11/2015

City Limits

0 2.5 5 Miles

EXHIBIT 1

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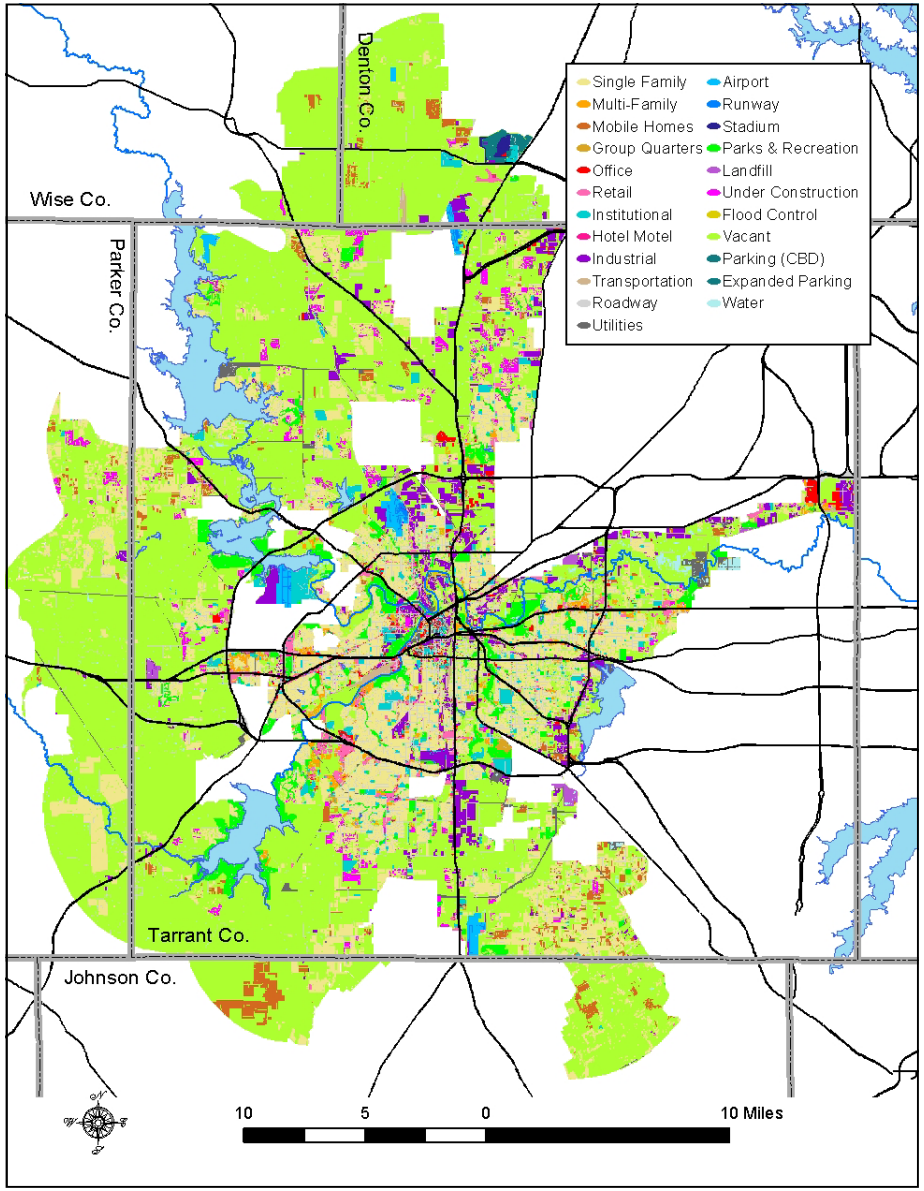
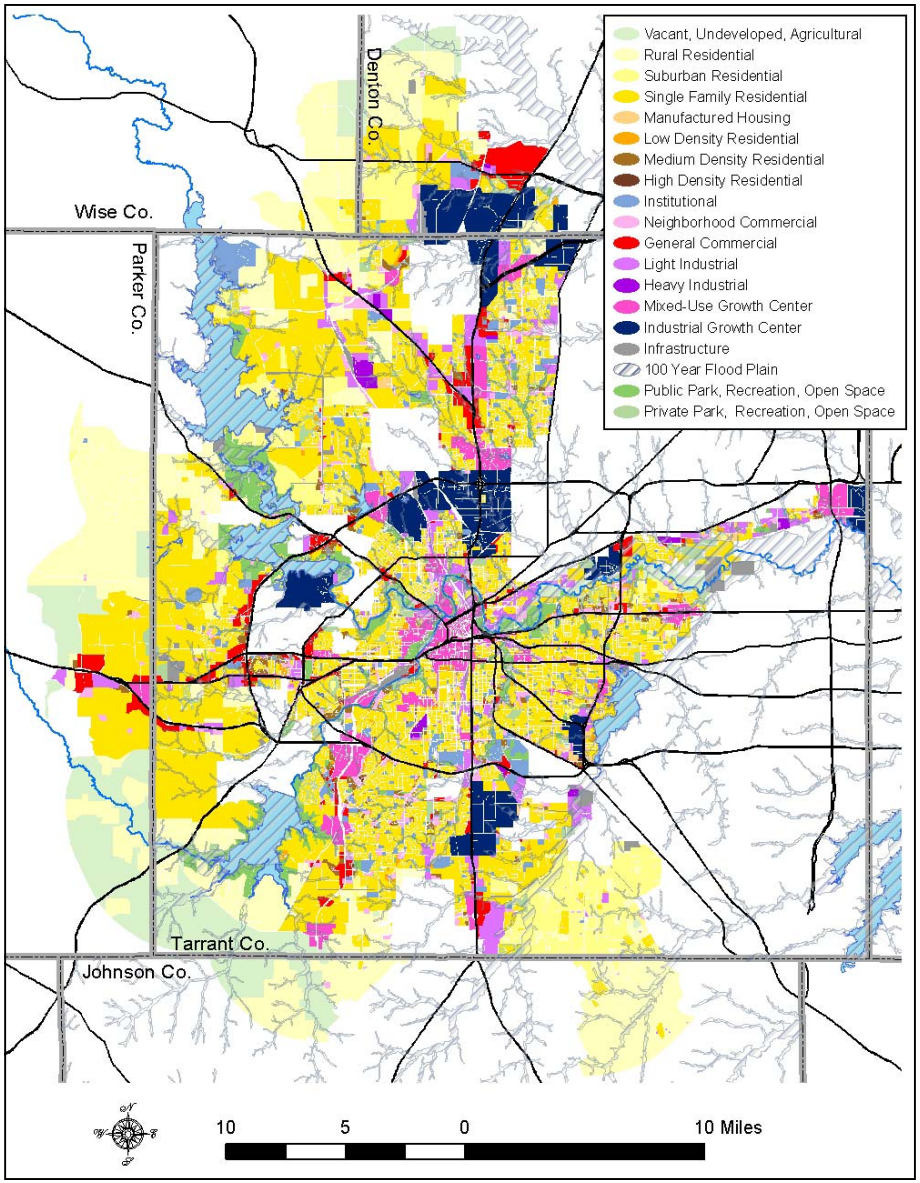
Existing Land Use
City of Fort Worth and ETJ, 2005



The most prevalent existing land use is single-family. Much of the city and its ETJ is currently undeveloped. *(Source: North Central Texas Council of Governments, 2006.)*

Future Land Use Plan
City of Fort Worth and ETJ



A comprehensive plan shall not constitute zoning regulations or establish zoning district boundaries.

Land uses are planned for all land within the current city limits and for land in the ETJ that could be available for development over the next 20 years. See Appendix C for individual sector maps at a larger scale. *(Source: Planning and Development Department, 2011.)*

Future and Existing Land Use
(from City of Fort Worth's Comprehensive Plan)

EXHIBIT 2

Hazard Assessment Map

EXHIBIT 3

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DATE: 9/11/2015

Legend

- City Limit
- Severe Repetitive Loss Property
- Repetitive Loss
- Drainage Complaints
- Public Meeting #1 Flood Reports
- Repetitive Loss Area

Floodplain Studies

- Open Channel Study Floodplains
- Storm Drain Planning Study Inundation
- 100 Yr FP
- 500 Yr FP

0 2.5 5
Miles

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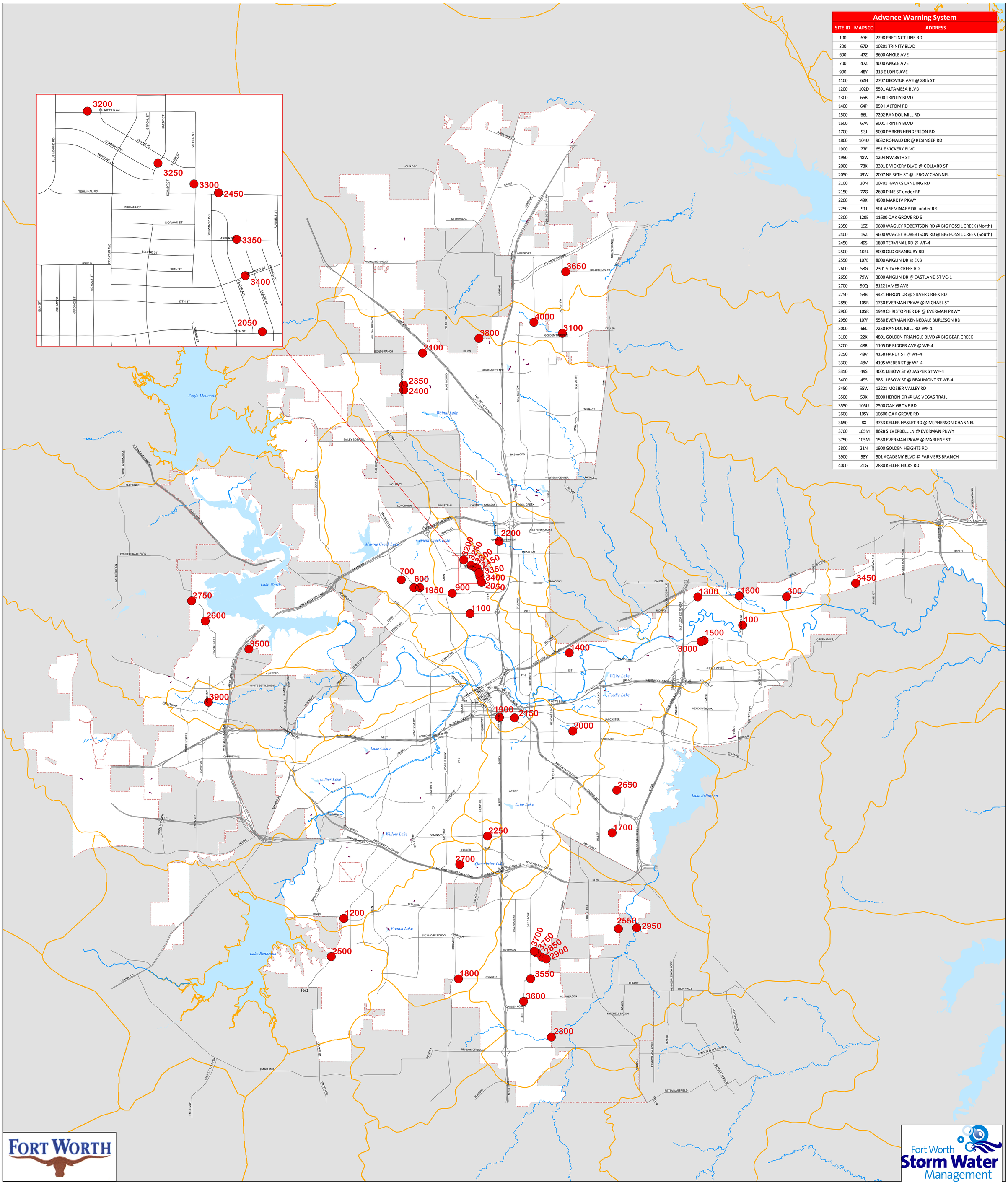
AWS Master Gauges



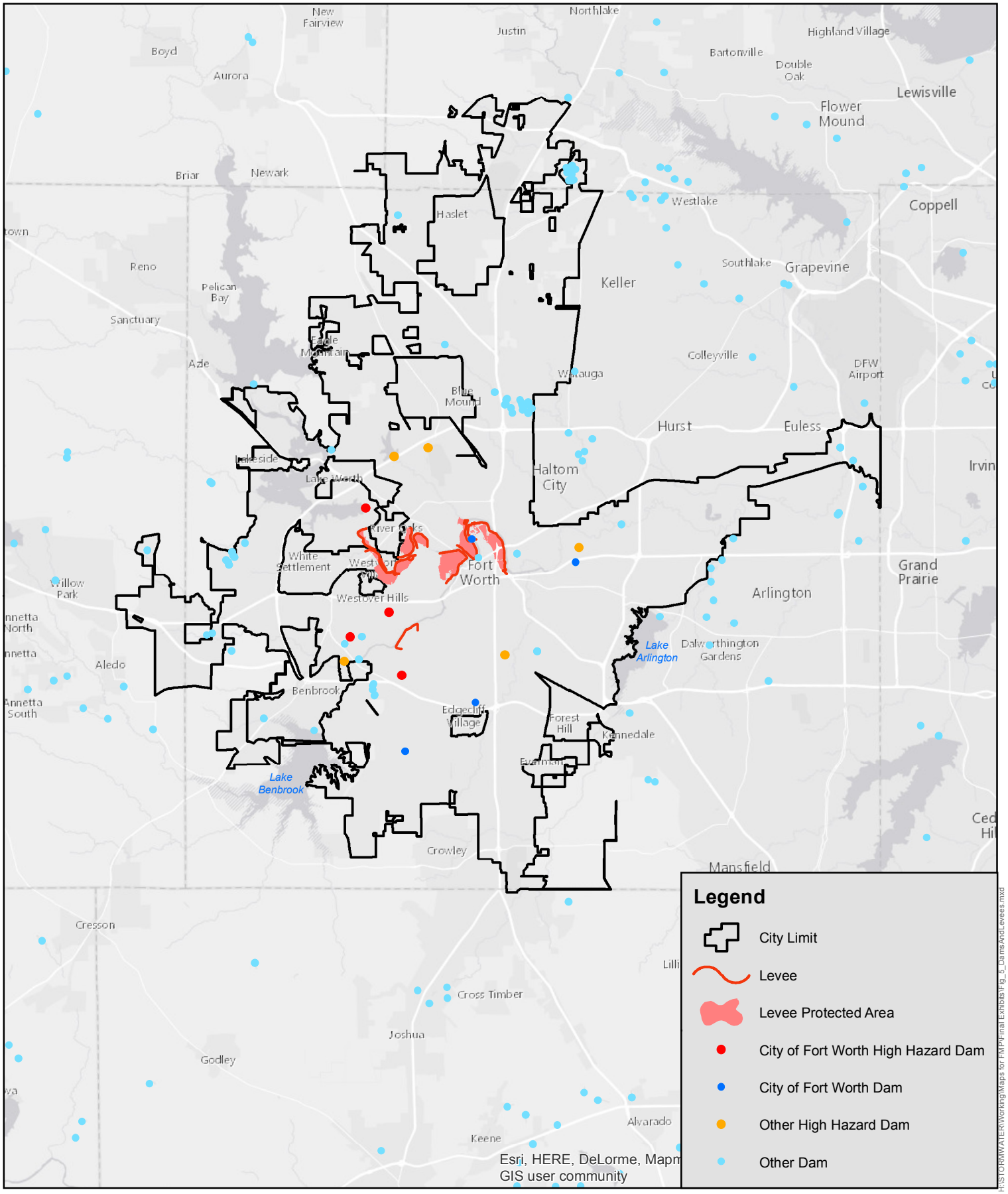
Advance Warning System		
SITE ID	MAPSCO	ADDRESS
100	67E	2298 PRECINCT LINE RD
300	67D	10201 TRINITY BLVD
600	47Z	3600 ANGLE AVE
700	47Z	4000 ANGLE AVE
900	48Y	318 E LONG AVE
1100	62H	2707 DECATUR AVE @ 28th ST
1200	102D	5591 ALTAMESA BLVD
1300	66B	7900 TRINITY BLVD
1400	64P	859 HALTOM RD
1500	66L	7202 RANDOL MILL RD
1600	67A	9001 TRINITY BLVD
1700	93J	5000 PARKER HENDERSON RD
1800	104U	9632 RONALD DR @ RESINGER RD
1900	77F	651 E VICKERY BLVD
1950	48W	1204 NW 35TH ST
2000	78K	3301 E VICKERY BLVD @ COLLARD ST
2050	49W	2007 NE 36TH ST @ LEBOW CHANNEL
2100	20N	10701 HAWKS LANDING RD
2150	77G	2600 PINE ST under RR
2200	49K	4900 MARK IV PKWY
2250	91J	501 W SEMINARY DR under RR
2300	120E	11600 OAK GROVE RD S
2350	19Z	9600 WAGLEY ROBERTSON RD @ BIG FOSSIL CREEK (North)
2400	19Z	9600 WAGLEY ROBERTSON RD @ BIG FOSSIL CREEK (South)
2450	49S	1800 TERMINAL RD @ WF-4
2500	102L	8000 OLD GRANBURY RD
2550	107E	8000 ANGLIN DR at EKB
2600	58G	2301 SILVER CREEK RD
2650	79W	3800 ANGLIN DR @ EASTLAND ST VC-1
2700	90Q	5122 JAMES AVE
2750	58B	9421 HERON DR @ SILVER CREEK RD
2850	105R	1750 EVERMAN PKWY @ MICHAEL ST
2900	105R	1949 CHRISTOPHER DR @ EVERMAN PKWY
2950	107F	5580 EVERMAN KENNEDALE BURLESON RD
3000	66L	7250 RANDOL MILL RD WF-1
3100	22K	4801 GOLDEN TRIANGLE BLVD @ BIG BEAR CREEK
3200	48R	1105 DE RIDDER AVE @ WF-4
3250	48V	4158 HARDY ST @ WF-4
3300	48V	4105 WEBER ST @ WF-4
3350	49S	4001 LEBOW ST @ JASPER ST WF-4
3400	49S	3851 LEBOW ST @ BEAUMONT ST WF-4
3450	55W	12221 MOSIER VALLEY RD
3500	59K	8000 HERON DR @ LAS VEGAS TRAIL
3550	105U	7500 OAK GROVE RD
3600	105Y	10600 OAK GROVE RD
3650	8X	3753 KELLER HASLET RD @ McPHERSON CHANNEL
3700	105M	8628 SILVERBELL LN @ EVERMAN PKWY
3750	105M	1550 EVERMAN PKWY @ MARLENE ST
3800	21N	1900 GOLDEN HEIGHTS RD
3900	58Y	501 ACADEMY BLVD @ FARMERS BRANCH
4000	21G	2880 KELLER HICKS RD

FORT WORTH

Fort Worth Storm Water Management

Prepared by Timothy B. Royer
Revised 03/20/15

Exhibit 4



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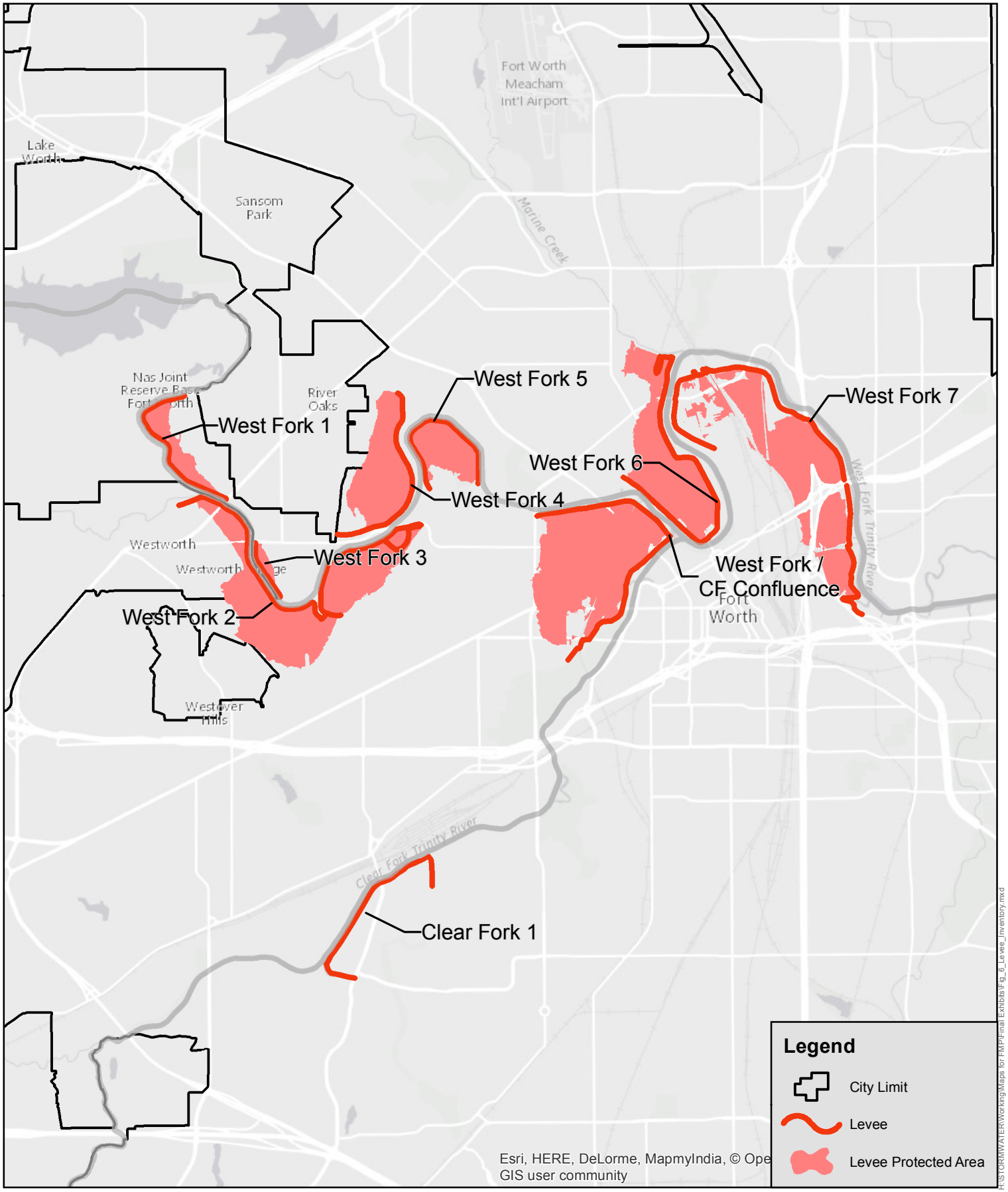
DATE: 9/14/2015

Dams and Levees

0 2.5 5 Miles

EXHIBIT 5



FILE: H:\STORMWATER\Working\Maps for FMP\Final Exhibits\Fig_6_Levee_Inventory.mxd

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Suite 200
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DATE: 9/14/2015

Levee Inventory

0 0.5 1 Miles

EXHIBIT 6

Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user

Legend

- City Limits
- 100 Year Depth Grid

Critical Facilities

- Airport Facilities
- Bus Facilities
- Care Facilities
- Emergency Centers
- Fire Stations
- Military
- Police Stations
- Schools
- Waste Water Facility

FILE: H:\STORMWATER\Working\Maps for FMP\Final Exhibits\Fig_7_HazusAnalysisOverview.mxd

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Fort Worth, Texas 76109
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JOB: FT115220 / DATE: 9/14/2015

Fort Worth Floodplain Management Plan

HAZUS Analysis: 100 Year Flood Input

EXHIBIT 7

0 2.5 5
Miles

Fort Worth Floodplain Management Plan

HAZUS Analysis: 100 Year Flood Results

The total economic loss estimated for the flood is 1,589.42 million dollars, which represents 8.11% of the total replacement value of the scenario buildings.

Legend

City Limits

Total Economic Loss by Census Block (in thousands of dollars)

- 1 - 500
- 501 - 1000
- 1001 - 2500
- 2501 - 5000
- 5001 - 10000
- 10001 - 20000
- 20001 - 50000

Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user

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JOB: FT115220 / DATE: 9/14/2015

EXHIBIT 8

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Miles

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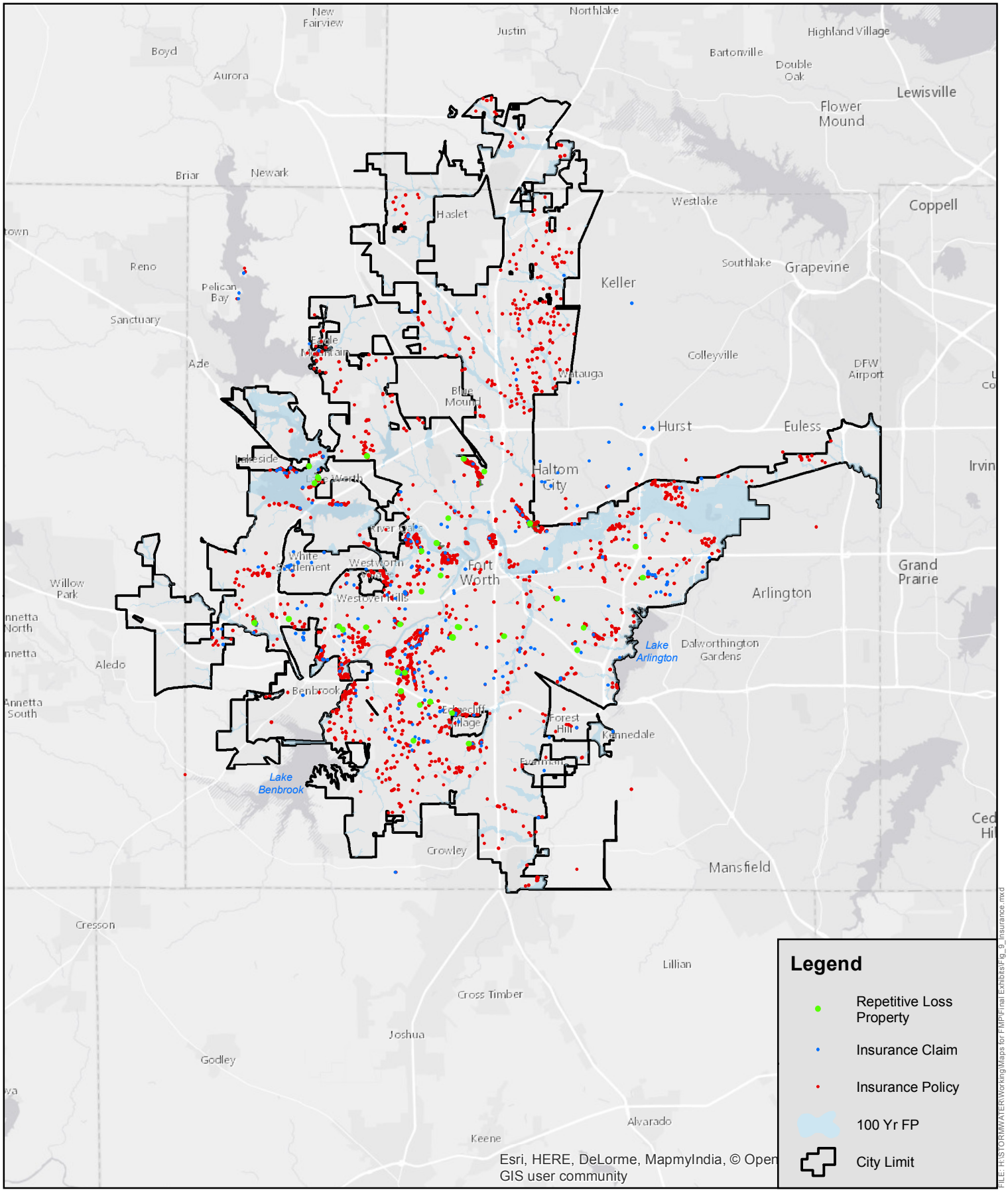

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Flood Insurance Claims and Policies

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4055 International Plaza
Suite 200
Fort Worth, Texas 76109
P: 817-735-7300 F: 817-735-7491
JOB: FT115220
DATE: 9/14/2015

0 2.5 5 Miles

EXHIBIT 9

Appendix B

Efforts to Involve the Public

Fort Worth
Storm Water
Management

inside:

Flood Insurance

Property Protection

Improvement Requirements

runoff *Rundown*

FORT WORTH STORM WATER MANAGEMENT DIVISION

The mission of the City of Fort Worth's Storm Water Management Division is to protect people and property from harmful storm water runoff. Education and prevention are valuable and proven tools that help can help communities become resistant to these natural disasters.

The City of Fort Worth recognizes that its entire community can be susceptible to flooding, not just those structures located within Special Flood Hazard Areas (SFHA's). The following information is being provided to help inform property owners located within the SFHA, flood prone areas, and also all property owners within the City of Fort Worth.

Flood Information

Residents of Fort Worth can obtain flood information concerning flooding, flood maps, mandatory flood insurance purchase requirements, and flood zone determinations from the City of Fort Worth's Transportation and Public Works Department (Storm Water Management Division) located at City Hall or by calling 817-392-6261.

Elevation certificates of some properties located in the Special Flood Hazard Areas (SFHA's) are on file in the Engineering Vault of the Transportation and Public Works Department located in City Hall. Copies of the available elevation certificates are available upon request.

Real time river gauge information can be obtained through the following website: www.usgs.gov.

A publication of the City of Fort Worth Transportation and Public Works Department
Storm Water Management Division

Fort Worth Storm Water Management

Flood Insurance

The purchase of federal flood insurance is highly recommended. Basic homeowner's insurance policies don't cover damage from floods. The City of Fort Worth participates in the National Flood Insurance Program (NFIP), which means that federally subsidized flood insurance is available to everyone in the City. Keep in mind that there is a 30-day waiting period before a policy becomes effective. Some people have purchased flood insurance because it was required by the bank or loan company when they obtained a mortgage or home improvement loan. Usually these policies just cover the building's structure and not the contents. Remember that a flood insurance policy must be renewed each year.

Mandatory Purchase Requirement: The mandatory purchase requirement applies to all forms of federal or federally related financial assistance for buildings located in a Special Flood Hazard Area (SFHA). This requirement affects loans and grants for the purchase, construction, repair or improvement of any publicly or privately owned buildings in a SFHA, including machinery, equipment, fixtures and furnishings contained in such buildings. If a building is located in a SFHA, the agency or lender is required by law to require the recipient to purchase a flood insurance policy on the building.

Community Rating System

The National Flood Insurance Program's Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed minimum requirements.

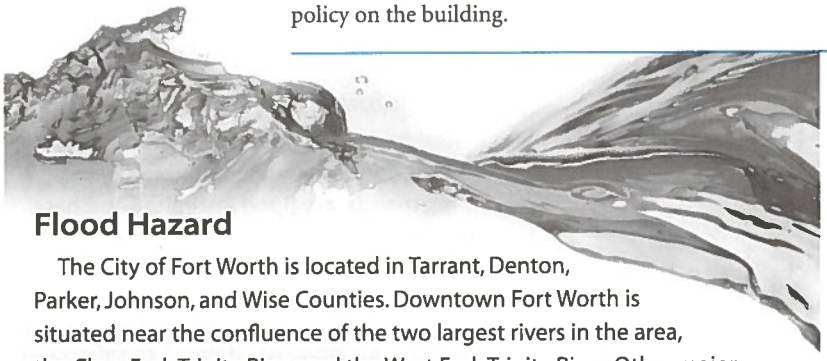
The City of Fort Worth is entering the CRS in the fall of 2011, and this will result in reduced flood insurance premium costs for homes or businesses in the floodplain. The three goals of the CRS are to reduce flood losses, facilitate accurate insurance ratings and to promote the awareness of flood insurance.

Flood insurance facts

> Affordable federal flood insurance is available to anyone living in Fort Worth who wants it, whether they are in a floodplain or not.
> Homeowner's insurance rarely, if ever, covers damage from floods.
> Typical flood insurance policies in Fort Worth for homes outside the floodplain run $200 to $300 per year.
> If you want to know if your home or business is in a floodplain, call 817-392-6261.

For more information about flood insurance contact:

> www.FortWorthTexas.gov
> www.fema.gov/nfip
> Your insurance agent.
> Customer Service for the City of Fort Worth's Storm Water Management Division at 817-392-6261.



Flood Hazard

The City of Fort Worth is located in Tarrant, Denton, Parker, Johnson, and Wise Counties. Downtown Fort Worth is situated near the confluence of the two largest rivers in the area, the Clear Fork Trinity River and the West Fork Trinity River. Other major streams in Fort Worth include Mary's Creek, Marine Creek, Sycamore Creek, Village Creek, Dry Branch Creek, Little Fossil Creek, Big Fossil Creek, and White's Branch.

Flooding in Fort Worth is typically produced by heavy rainfall from frontal type storms that occur during the spring and fall months. Flash floods are the most common type of flooding in Fort Worth. A flash flood is a rapid rise of water along a stream or low lying area as a result of an intense amount rainfall in a short period of time. Fort Worth has also experienced a number of major flood events since its settlement in 1849. Historical information indicates that significant floods occurred in Fort Worth in May 1866, May 1908, April 1922, February 1938, June 1941, April 1942, May 1949, May 1957, August 1974, July 1975, November 1981, May 1989, and May 1990.

Flood Protection Assistance

Concerned residents and the general public can obtain information on flood protection assistance from the City of Fort Worth's Transportation and Public Works Department Storm Water Management Division by calling 817-392-6261. Flood protection assistance, flood related data, data on historical flooding in neighborhoods and other information provided by the City of Fort Worth is site specific, so inquirers can relate the flood threat to their problems.

List of Services Provided:

- Make site visits to review flooding and drainage and problems and provide one-on-one advice to property owners.
- Provide assistance with floodplain development permits, determination of Base Flood Elevations (BFE) and general information on all flood insurance and floodplain mapping procedures and forms.
- Provide advice and assistance on retrofitting techniques, such as elevating buildings above flood levels or the Base Flood Elevation, dry flood proofing and wet flood proofing.

Property Protection

Rather than wait for a flood to occur, you can act now to protect your property from flood damage. Various alternatives are available to help minimize flooding. If the floor level of your property or structure is lower than the Base Flood Elevation (BFE) located on the City's Flood Insurance Rate Map (FIRM), consider ways to prevent flooding from occurring, such as retrofitting your building. "Retrofitting" means altering your building to eliminate or reduce flood damage. Retrofitting measures include:

> Elevating the building so that flood waters do not enter or reach any damageable portion of it,
> Constructing barriers out of fill or concrete between the building and flood waters,
> "Dry flood proofing" to make the building walls and floor watertight so water does not enter,
> "Wet flood proofing" to modify the structure and locate the contents so that when flood waters enter the building there is little or no damage, and
> Preventing basement flooding from sewer backup or sump pump failure.

There are several good references on retrofitting in the Fort Worth Central Library located at 500 W. Third St. Many of these will inform you about retrofitting techniques and help you decide which is best for you.

Natural and Beneficial Functions

The City of Fort Worth is a beautiful place to live, work and play. The floodplains and adjacent waters are important assets that form complex physical and biological systems. When floodplains are preserved in their natural state, they provide open space areas for parks, bike paths and wildlife conservation.

Floodplains also reduce the severity of floods by conveying storm water runoff, providing flood storage and conveyance, reducing flood velocities, flood peaks and minimizing sedimentation. The natural vegetation in the floodplain improves the water quality of the lakes and rivers of Fort Worth by slowing down storm water runoff, which allows sediments and other impurities to settle out.

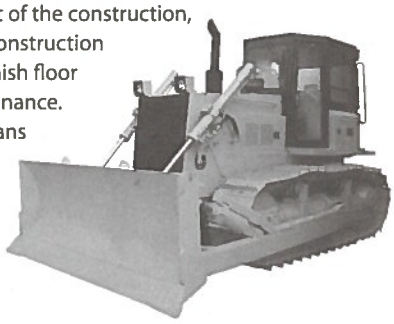
Floodplain Development Permit Requirements

All development within the City of Fort Worth requires local and state permits. Contact the City of Fort Worth's Planning and Development Department at 817-392-2222 for advice before you build, fill, place a manufactured home or otherwise develop.

The zoning ordinance, Floodplain Provisions Ordinance and the International Building Codes have special provisions regulating construction and other developments within floodplains. Without these provisions, affordable flood insurance through the National Flood Insurance Program (NFIP) would not be available to property owners in the City of Fort Worth. Any development in the floodplain without a permit is illegal. Such activity can be reported to the Storm Water Management Division's Customer Service at 817-392-6261.

Substantial Improvement Requirements

What is substantial improvement? The NFIP requires that if the cost of any reconstruction, rehabilitation, addition or other improvement to a structure exceeds 50% of the market value of the structure before the start of the construction, the improvements must conform to or meet the same construction requirements as a new building and satisfy minimum finish floor requirements specified in the Floodplain Provisions Ordinance.



What is substantial damage? Substantial damage means damage of any origin sustained by a building or structure when the cost of restoring the building to its pre-damaged condition would equal or exceed 50% of the market value of the building before the damage occurred. Substantial damage is determined regardless of the actual repair work performed.

The City of Fort Worth requires by ordinance that any substantial improvement or substantial damage improvement must have a building permit. Building permits can be obtained at the Planning and Development Department located at City Hall or by calling 817-392-2222.

Drainage System Maintenance

The City of Fort Worth's Storm Water Management Field Operations crews work hard to maintain the drainage systems throughout the city. It is illegal in the City of Fort Worth to dump any type of debris into a stream, river or drainage ditch. This debris can become entangled in culverts, shallow streambeds, or drainage ditches and impede drainage causing the flow of water to back up. Residents of Fort Worth should also keep drainage ditches on their property free of debris, foliage and vegetation that would impede the flow of water. Debris dumping should be reported to the City of Fort Worth's Code Compliance Department by calling 817-392-1234.

FORT WORTH

City of Fort Worth
Transportation and Public Works Department/Storm Water Management
1000 Throckmorton Street
Fort Worth, TX 76102

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Fort Worth
Storm Water
Management

Visit us online at
www.FortWorthTexas.gov/tpw/stormwater

Flood Safety

Turn Around, Don't Drown

> Learn the safest route from your home or business to higher, safer ground, but stay tuned to reports of changing flood conditions.

> If emergency officials tell you to evacuate or leave your home, go immediately to a safe shelter, hotel or relative's house.

> Turn of all utilities, gas and electricity at the main switch. Stay away from power lines and electrical lines. Be alert for gas leaks.

> Do not walk through flowing water. Drowning is the number one cause of flood related deaths. Currents can be deceptive; just six inches of moving water can knock you off your feet!

> Do not drive through a flooded area. More people drown in their cars than in any other location. Vehicles also push water into homes and cause additional property damage.

Important Useful Websites

www.fema.gov
www.noaa.gov
www.floods.org
www.usgs.gov
www.nws.noaa.gov
www.weather.gov
www.FortWorthTexas.gov/tpw/stormwater

Flood Warning System

The Emergency Alert System will notify City of Fort Worth residents via local radio and TV, if flooding is imminent and if evacuation of the City is advised.

Additionally, the NOAA Weather Station Radio broadcasts weather information including warnings, watches, forecasts, and other hazard information at 162.550 MHz 24 hours a day, 7 days a week from the National Weather Service Office in North Central Texas. The local contact number is 817-429-2631. Please call in reference to evacuation notices, procedures and shelters.

About Fort Worth

City Council
- Pre-Council Agenda
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- Council Packet
- Boards, Commissions and Committees
- City Code & Charter
- Elections

Public Information
- Financial Information

Departments

Business
- Vendors
- Hotel Tax Remittance
- Minority/Women Business Enterprise
- Title VI
- Business Assistance Center
- Zoning Map
- Incentive Map

Visitors
- Events around Fort Worth

Public Safety
- Flood Safety & Insurance
- KnoWhat2Do in an emergency
- Special Needs Assistance Program (SNAP)

Sustainability
- Bike Fort Worth
- Business Smart

Home > News

How you can participate in developing the city's Floodplain Management plan

Posted May 24, 2015

Archived Content
Information and links provided may no longer be accurate.

As part of its participation in the National Flood Insurance Program's Community Rating System, the City of Fort Worth is working with the community and business leaders to create a comprehensive Floodplain Management Plan.

The plan will identify potential flood risks, help understand their impact on the community and provide a prioritized action plan and framework for reducing flood risks in the future.

As part of the process, the city will analyze where flooding is currently occurring, both inside and outside of the floodplain. The city will also map flood hazard areas and take an inventory of levees and dams that could be at risk for flooding.

Once the hazards are assessed, the city will look at overall impact to the community. This includes possible impact to life, safety and public health, as well as the potential economic impact of flooding in Fort Worth.

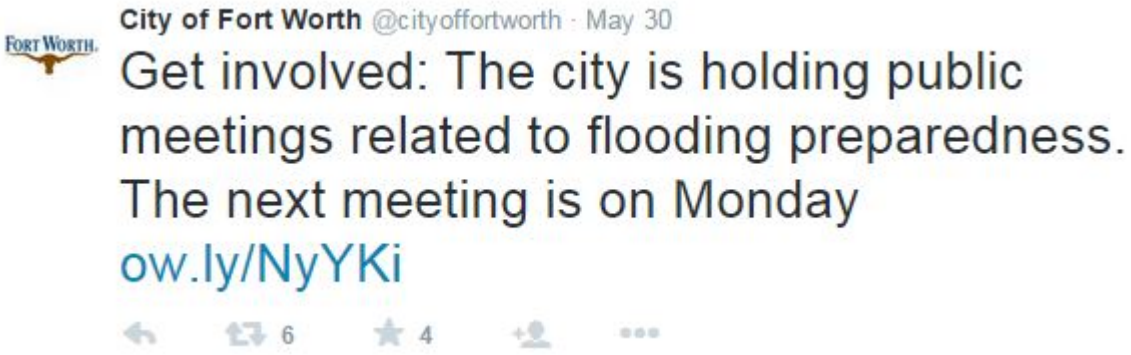
After identifying the impacts, the city will develop a prioritized action plan for mitigating flood risks, with the goal of making Fort Worth a more resilient community.

To develop and adopt an effective plan, the city is seeking input from stakeholders and the public. Share your flooding concerns and get involved by attending an upcoming public meeting, or visit the Floodplain Management Plan project page to learn about more opportunities to give feedback.

City Website Page that Encourages Public Involvement

City Website Providing Info to Public about Fort Worth Floodplain Management Plan

Posting About Public Meeting #1 on City of Fort Worth Facebook Page



City of Fort Worth Twitter Post Inviting Citizens to Public Meeting #1

FORT WORTH.

This Week @ City Hall

Monday, June 1- Sunday, June 7, 2015

Public Meetings

Date/Time	Meeting
Monday 6/1 6-8 p.m.	**Floodplain Management Plan Public Meeting**, Hazel Harvey Peace Center for Neighborhoods, 818 Missouri Ave.
Tuesday 6/2 11 a.m.	**Legislative and Intergovernmental Affairs Committee**, Pre-Council Chamber
Tuesday 6/2 1 p.m.	**Housing and Economic Development Committee**, Pre-Council Chamber
Tuesday 6/2 3 p.m.	**Pre-Council Meeting**, Pre-Council Chamber
Tuesday 6/2 7 p.m.	**Council Meeting**, Council Chamber
Thursday 6/4 5:30 p.m.	**Crime Control and Prevention District Board**, Pre-Council Chamber
Thursday 6/4 6:30 p.m.	**Fort Worth Library Advisory Board Meeting**, Wedgwood Branch Library, 3816 Kimberly Lane

Special Events

Date/Time	Event
Monday 6/1 11:45 a.m.	**Longhorn Toastmasters Club**, Development Conference Room
Tuesday, 6/2	**Tuesday Evening Permitting.** Permit applications taken until 7 p.m.
Thursday, 6/4 7 p.m.	**Movies That Matter:** ***The Untold Story of Emmett Louis Till,*** Modern Art Museum of Fort Worth, 3200 Darnell St.
Saturday, 6/6 9-11 a.m.	**Crud Cruiser Mobile Collection**, Eugene McCray Community Center, 4932 Wilbarger St.
Saturday, 6/6 Noon-2 p.m.	**Crud Cruiser Mobile Collection**, Highland Hills Community Center, 1600 Glasgow Road
Saturday, 6/6 10 a.m.-10 p.m.	**PantherFest**, North Main Street Bridge

City Hall Weekly Calendar that Shows Public Meeting #1

Invite (/invitation_em…

LOCAL

Hulen Bend Estates (/nei…
Nearby Neighborhoods (…
Local Agencies (/agency…

CATEGORIES

Classifieds (/classifieds/)
Crime & Safety (/crime…
Documents (/documents/)
Free items (/free/)
General (/general/)
Lost & Found (/lost_and…
Recommendations (/rec…

Get Involved!

As part of its floodplain management and planning process, the City of Fort Worth Stormwater Management Division is holding several public meetings related to flooding preparedness. We would like to hear your input.

Next meeting: June 1, from 6 p.m. - 8 p.m.

Location: Hazel Harvey Peace Center for Neighborhoods, 818 Missouri Ave.

To learn more, visit http://fortworthtexas.gov/stormwater/flo... (http://fortworthtexas.gov/stormwater/floodplain/)

Shared with all areas in Fort Worth Community Engagement Office (/agency/fort-worth-neighborhood-education-office/) in Crime & Safety (/crime_and_safety/)

THANK 46

Announcement Made Through Neighborhood Associations

Home > Transportation & Public Works > Stormwater

Floodplain Management Plan

What is the Floodplain Management Plan?

The City of Fort Worth is working on a Floodplain Management Plan for the entire city. This will be the first part of a growing public planning and interaction program being led by the Stormwater Management Division.

This plan will identify flood risks, their impact on the community and a prioritized action plan for reducing flood risks.

An eye on the bottom line

By completing this plan, the city will not only be on a path to becoming safer and more resilient to flooding hazards, but it will also improve Fort Worth's National Flood Insurance Program (NFIP) Community Rating System (CRS) score. Improving the city's CRS score will reduce eligible flood insurance premiums, which will save money for citizens and businesses.

Get Involved

- Which types of flood mitigation activities should be teh highest priority for the City of Fort Worth?
- Which types of public information activities would you support?
- Structural projects keep flood waters away from an area with pipes, channels, or storage features. Which type of structural projects would you support?
- When flooding occurs, emergency services measures are taken to minimize the impact. Which types of emergency services would you support?

Watch this web page and City News for opportunities to provide feedback.

Floodplain Feedback

Have questions? Use this form to ask our planners.

Question/Comment *

Your email address *

Submit

Flood Facts

- Flood damages in Fort Worth occur more often outside the FEMA floodplains than inside.
- The flood insurance policies outside the floodplain have experienced 73 percent more damages than inside the FEMA floodplain.
- Just a few inches of water from a flood can cause tens of thousands of dollars in damage.

Source: National Flood Insurance Program

Upcoming Meetings

Management Plan Public Meeting No. 2: 6 p.m. Sept. 28, 2015; Hazel Harvey Peace Center for Neighborhoods, 818 Missouri Ave.

Past Meetings

Committee Meeting: May 18, 2015; Hazel Harvey Peace Center for Neighborhoods, 818 Missouri Ave.

Public Meeting: June 1, 2015; Hazel Harvey Peace Center for Neighborhoods, 818 Missouri Ave.

Committee Meeting: Aug. 4, 2015; Hazel Harvey Peace Center for Neighborhoods, 818 Missouri Ave.

Downloads

- Planning Committee Presentation No. 1 (May 18, 2015)
- Public Meeting Presentation No. 1 (June 1, 2015)

Posting on City of Fort Worth Website about Public Meeting #2

Home > Transportation & Public Works > Stormwater

Fort Worth Stormwater Management

When rain hits any hard surface, such as your roof or driveway, it can't soak into the ground so it runs off your property. Uncontrolled runoff can lead to flooding, erosion and pollution problems. It is the city's job to help control this runoff.

The city's Stormwater Management program is working to modernize the Fort Worth storm water system and educate the public about the dangers of flash flooding.

- Development in the floodplain
- Drainage system maintenance
- Flood insurance
- Flood safety
- Understanding the floodplain

Spotlight

runoff Rundown

Learn more about the Floodplain Management Plan

The City of Fort Worth is working on a Floodplain Management Plan for the entire city. This will be the first part of a growing public planning and interaction program being led by the Stormwater Management Division.

Flood Information

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Elevation certificates of some properties located in the Special Flood Hazard Areas (SFHA's) are on file in the Engineering Vault of the Transportation and Public Works Department located in City Hall. Copies of the available elevation certificates are available upon request.

Real time river gauge information can be obtained through the following website: www.usgs.gov.

Customer Service

- View Stormwater Utility rates and other information.
- If you have reported a stormwater issue or received a door tag from city staff, let us know about your experience.

Links

- Association of State Floodplain Managers
- Environmental Protection Agency
- Federal Emergency Management Administration
- National Oceanic and Atmospheric Association
- National Weather Service
- North Central Texas Council of Governments
- Tarrant County
- Tarrant Regional Water District
- Tarrant Water Development Board
- Texas Commission on Environmental Quality
- Texas Department of Transportation
- Trinity River Authority
- Trinity River Vision
- U.S. Army Corps of Engineers
- U.S. Geological Survey

Link on City of Fort Worth Website to Runoff Rundown Newsletter

Posting About Public Meeting #1 on City of Fort Worth Facebook Page

City of Fort Worth Twitter Post Inviting Citizens to Public Meeting #2

FLOODPLAIN MANAGEMENT PLAN
PUBLIC COMMENT CARD

Name: _____ Phone: _____

Physical address: _____

Email address: _____

1. Do you live in a floodplain? (Y) (N) UNSURE
2. Do you have flood insurance? (Y) (N) UNSURE
3. Has your property flooded before? (Y) (N) UNSURE

_____

(If yes, please describe and provide address if different than above)

_____

4. Do you know of any flood prone areas that you would like to make the city aware of? (Y) (N) UNSURE

_____

(If yes, please describe)

5. Which type of flood risk mitigation activities would you support? (Examples on the back, check all that apply)
   - *Preventive activities (zoning, floodplain regulations, building codes, subdivision, ordinances)*
   - *Natural floodplain function protection activities*
   - *Property protection and mitigation activities*
   - *Emergency service activities*
   - *Public information activities*
6. Any other comments you would like to share? _____

_____

_____

_____

FORT WORTH.

Stormwater Mission: To protect people and property from harmful stormwater runoff.

Stormwater Management

Front Side of Comment Card Distributed at Public Meeting #1

1. **Preventive** activities keep flood problems from getting worse. The use and development of flood-prone areas is limited through planning, land acquisition, or regulation. They are usually administered by building, zoning, planning, and/or code enforcement offices.

   - Floodplain mapping and data
   - Open space preservation
   - Floodplain regulations
   - Coastal setback/erosion regulations
   - Planning and zoning
   - Stormwater management
   - Drainage system maintenance
   - Building codes

2. **Property protection** activities are usually undertaken by property owners on a building-by-building or parcel basis.

   - Relocation
   - Acquisition
   - Building elevation
   - Retrofitting
   - Sewer backup protection
   - Insurance

3. **Natural resource protection** activities preserve or restore natural areas or the natural functions of floodplain and watershed areas. They are implemented by a variety of agencies, primarily parks, recreation, or conservation agencies or organizations.

   - Wetlands protection
   - Erosion and sediment control
   - Natural area preservation
   - Natural area restoration
   - Water quality improvement
   - Coastal barrier protection
   - Environmental corridors
   - Natural functions protection

4. **Emergency services** measures are taken during an emergency to minimize its impact. These measures are usually the responsibility of city or county emergency management staff and the owners or operators of major or critical facilities.

   - Hazard threat recognition
   - Hazard warning
   - Hazard response operations
   - Critical facilities protection
   - Health and safety maintenance
   - Post-disaster mitigation actions

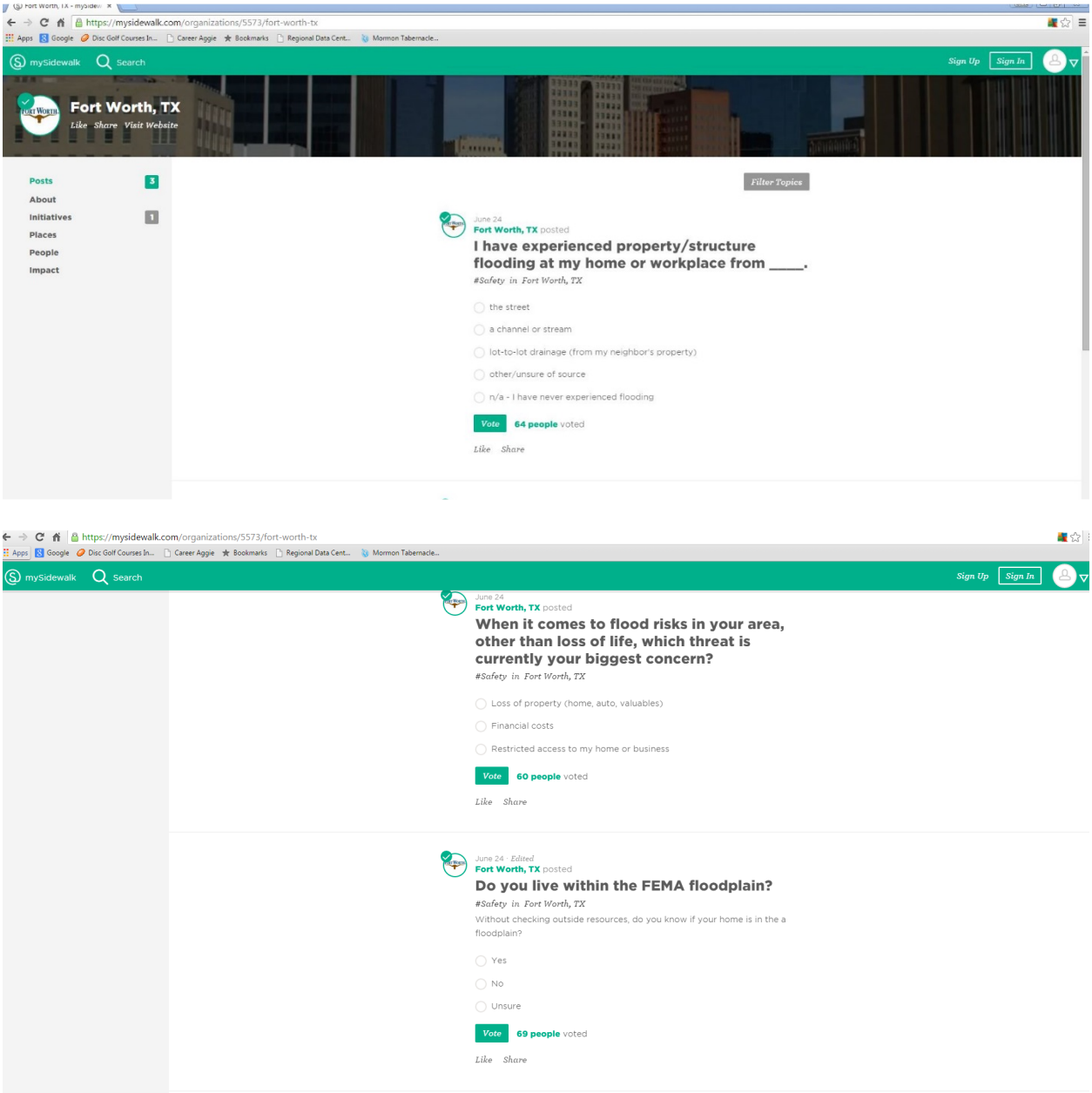
5. **Structural projects** keep flood waters away from an area with a levee, reservoir, or other flood control measure. They are usually designed by engineers and managed or maintained by public works staff.

   - Reservoirs
   - Levees/floodwalls
   - Diversions
   - Channel modifications
   - Storm drain improvements

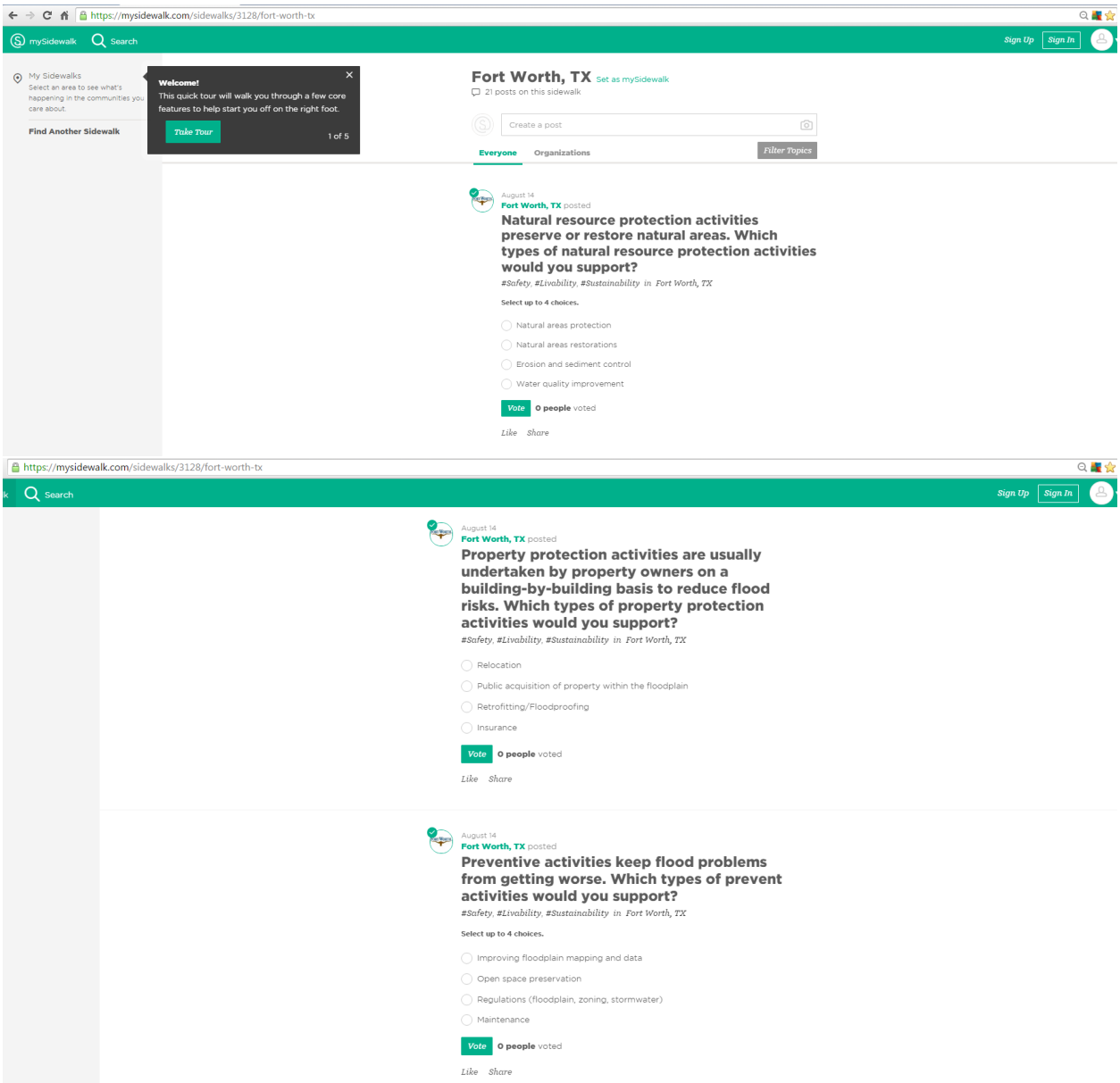
6. **Public information** activities advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards, and the natural and beneficial functions of local floodplains. They are usually implemented by a public information office.

   - Map information
   - Outreach projects
   - Real estate disclosure
   - Library
   - Technical assistance
   - Environmental education

Backside of Comment Card Distributed at Public Meeting #1



Survey 1 posted on My Sidewalk website



Survey 2 posted on My Sidewalk website

Table B-1: Results to "mysidewalk" Survey

Views	Question	Responses				
2,153	Do you live within the FEMA floodplain?	**Yes**	**No**	**Unsure**		
		10	48	22		
2,199	When it comes to flood risks in your area which threat is currently your biggest concern?	**Loss of Property**	**Financial Costs**	**Restricted Access to home/business**		
		30	27	13		
2,287	I have experienced property/structure flooding at my home or from _____?	**Street**	**Stream or Channel**	**Lot-to-lot Drainage**	**Other**	**N/A**
		5	3	9	1	58

Stormwater Mission: To protect people and property form harmful Stormwater Runoff.

MEETING MINUTES

PROJECT:	Fort Worth Floodplain Management Plan
NAME OF MEETING:	Stakeholder Planning Group Meeting #1
RECORDED BY:	Scott Hubley, FNI, Katie Hogan, FNI, Ron Rogers, OCG
DATE:	5/18/2015
LOCATION:	Hazel Harvey Peace Center for Neighborhoods
DATE SENT:	5/22/2015
ATTENDEES:	See Item 2 for Committee Members and attendees

The following reflects our understanding of the items discussed during the subject meeting. If you do not notify us within five working days, we will assume that you are in agreement with our understanding.

ITEM	DESCRIPTION	PRESENTER
1.	Clair Davis, Floodplain Administrator for City of Fort Worth (CFW) introduced the City's intention to develop a Floodplain Management Plan (FMP). Clair gave a brief discussion regarding flooding within the City and CFW participation in the NFIP as well as the CRS program. Refer to slides for additional information.	Clair
2.	The committee members were introduced. The members present at the meeting include: Linda Sterne, Clair Davis, Cindy Robinson, Kent Lloyd, Ron Shearer, Jennifer Dyke, Mary Kelleher, Larry Langston, Mikel Wilkins, Bobbie McCurdy, Joel McElhany, Rick Kubes, Eric Fladager, Jim Austin Members part of the committee but unable to attend include: La Wayne Hauser, Libby Willis, Joe Waller, Joe Schneider, Keith Wells Other attendees: Steve Eubanks, Scott Hubley, Katie Hogan, Veronica Carneal, Greg Simmons, Juan Ortiz, Alex Rivera, Art Basher, Ron Rogers, Mary Hanna Members who were unable to attend were provided the information discussed at the meeting via email and phone.	All
3.	The committee members discussed their experiences with flooding in their communities, businesses, or homes. One member commented that she has lived in the Central Arlington Heights neighborhood and has been subject to severe flood damage in the past. The person had no insurance and was not aware of the need for it. Water got as high as a person's neck and the person was unable to recover due to the economic loss. The member stressed the importance of getting information to the masses about safety issues and flood insurance in the City. Another member discussed their experiences with flooding living within the floodplain. This person experienced loss of property and livestock after development upstream occurred.	Group

ITEM	DESCRIPTION	PRESENTER
	A third member recalled an event at his store on Berry Street where nearby businesses had flooded, and sand bags had to be placed to prevent damage to the store. The store did not experience flooding directly, but has suffered damage due to water from water pipes.	
4.	Scott Hubley with Freese and Nichols, Inc. (FNI) discussed the purpose and development of the FMP. He went through steps required to obtain CRS credit for the plan and discussed the FMP committee involvement.	Scott
5.	A group discussion was held to develop goals for the FMP and mitigation actions. These goals tie into the City's overall goals as well as the stormwater management goals. Additions to the goals included incorporating regional solutions rather than just localized ones, where feasible. The committee members brought up the following points regarding goals and potential mitigation options: 1. Public safety is the primary issue. Flooding potentially not only causes loss of property, but also loss of life. 2. Floodplain development and plans should consider fully developed conditions, not just existing. 3. Structural improvements to reduce flooding and encourage detention solutions. 4. Incorporate existing studies and mitigation actions identified within this plan. 5. Improve public knowledge and participation in the flood insurance program. 6. Use open property for ponds and parks, including mapped floodplain areas. 7. Underground storage and reusing stormwater was also suggested. 8. Drones could be used to identify flood issues after a large storm event. 9. Create a lake on the east side of Fort Worth in the floodplain and floodway areas which would assist with flood control and water supply.	Scott/Group
6.	A member stressed the importance of making the public aware of what is covered and what is not under homeowners insurance with regards to flooding. Rising waters are considered not covered; however, water damage due to winds or pipes are covered. Separate floodplain insurance is required for rising water issues.	Member
7.	The timeline of the project was discussed as well as future meetings. Public outreach was included as an important part of the project. The committee meetings will be held at the same location in the future for consistency. At least 2 more committee meetings and 2 public meetings will be held.	Scott

ITEM	DESCRIPTION	PRESENTER
8.	A member recommended using a blog or facebook page to post ideas and comments. The City is currently working on developing a plan to do so.	Member
9.	A member questioned where the runoff leads within the City of Fort Worth. The City responded that the storm drains and infrastructure drains to the Trinity.	Clair
10.	The committee mentioned that the City needs to work as a whole with departments working together to solve issues.	Committee

ACTION ITEMS			
WHAT	**WHO**	**WHEN**	**STATUS**
1. Prepare FMP goals based on committee meeting comments	City/FNI	By next meeting	In progress
2. Develop a hazard assessment profile for flooding in the City of Fort Worth	City/FNI	July	In Progress
3. Hold a Public Meeting to encourage public participation in the plan	City/FNI/OCG	June 1	Scheduled

Stormwater Mission: To protect people and property from harmful Stormwater Runoff.

MEETING MINUTES

PROJECT:	Fort Worth Floodplain Management Plan
NAME OF MEETING:	Public Meeting #1
RECORDED BY:	Scott Hubley, FNI, Katie Hogan, FNI, Ron Rogers, OCG
DATE:	6/1/2015
LOCATION:	Hazel Harvey Peace Center for Neighborhoods
DATE SENT:	6/5/2015
ATTENDEES:	City of Fort Worth Staff FNI personnel Open Channels Personnel 36 Citizens

The following reflects our understanding of the items discussed during the subject meeting. If you do not notify us within five working days, we will assume that you are in agreement with our understanding.

ITEM	DESCRIPTION	PRESENTER
1.	**Clair Davis**, P.E., CFM introduced himself as the Floodplain Administrator for the Stormwater Management Division of the City of Fort Worth. He also introduced **Scott Hubley**, P.E., CFM, and project manager for the development of the floodplain plan with Freese & Nichols, Inc. Purpose of the meeting: gather public input for the City's Floodplain Management Plan (FMP). This is in conjunction with FEMA's National Flood Insurance Program (NFIP) Community Rating System (CRS).	City
2.	Fort Worth recent rainfalls were mentioned and Clair let the community know that the City is monitoring the events and flooding within the City. • To report flooding in your area, call: 817-392-8100. The City needs resident help to understand flood-prone areas in the City. • The recent rainfall may seem like a lot cumulatively, the events were not extreme. This plan is important to help prevent flooding in extreme events as well as during extended periods of rain. The following historically large flood events for Fort Worth were mentioned: • The 1908 flood when residents watched from the Main St. bridge • 4/25/1922 flood • May 17, 1949 recorded 11" of rainfall in 9 hours. The Trinity rose more than 40'.	City
3.	Clair discussed the difference between a riverine floodplain and flooding due to stormwater outside of the floodplain. The presentation included photos to show some areas in the City that flood outside the floodplain:	City

ITEM	DESCRIPTION	PRESENTER
	• Central Arlington Heights dated 2004 • Bellaire at Stadium by TCU dated 2004 • Berry St. dated 2004	
4.	A brief video was shown from FloodSmart.gov that features a couple talking about their flooding experiences and what having flood insurance meant to them.	City
5.	Clair spoke about Fort Worth's higher floodplain standards than required by FEMA. The City also participates in National Flood Insurance Program (NFIP) and the Community Rating System (CRS). He included the following comments regarding the participation in the NFIP and CRS: • The NFIP provides lower cost flood insurance and is available to anyone in Fort Worth who wants it. • The average policy premium in 2012 was $650 per year. • NFIP paid out more than $7.7 billion in claims nationally in 2012. • Fort Worth's participation in the NFIP has reduced flood claims by **84%.**There were 321 flood claims prior to the City's participation and FEMA Flood Insurance Rate Maps (FIRM) and 38 post-FIRM claims. • Community Rating System (CRS) participation is voluntary and Fort Worth began participating in 2012. The CRS is a program that can lower flood insurance rates for participating communities. • Fort Worth's CRS rating is currently 8. The score is from 1-10, where a lower score relates to reduced flood insurance rates.	City
6.	The Fort Worth Stormwater Utility was created in 2006 and the following items were discussed: • A fee on property owners' water bills goes toward stormwater management. • A Resident asked where comments can be left for flooding in the City. o City Response: The City is currently taking comments regarding this plan, but would also like to hear about any other issues the residents would like to discuss. • A resident asked if impervious cover was considered and updated with the City's fee. o City Response: The City does keep a database of impervious cover and developers are required to submit their increase of impervious cover. The area goes into determining the stormwater utility fee. • A resident question was raised about the maintenance schedule for the stormwater drains.	City/Resident

ITEM	DESCRIPTION	PRESENTER
	o City Response: The City has a crew that works to maintain those drains. Each drain is on schedule to be cleaned out once every five years; however, the maintenance crews may go off the schedule to clean clogged drains if they are reported by residents. • Resident responded that the reason for asking is that the flooding is a lot worse when they get clogged, and it seems that would be a good prevention measure. o City Response: The City promotes prevention of flooding and agreed that cleaning systems is a good prevention measure. • Resident asked if the city put a culvert under someone's property to prevent major flood drainage problems. o City Response: The City would have to look into the problem on an individual basis. Please use the stormwater number to report flooding issues.	
7.	Scott Hubley gave an overview of the 510 Floodplain Management Plan. This overview started with a slide illustrating the process for plan development (organize, assess, develop mitigation plan, adoption, and implementation). Scott also discussed the following items regarding the plan development: • The city is creating this plan for flooding hazards because it is a significant hazard within the City of Fort Worth. The plan also provides assistance in lowering the City's CRS score. • Part of the process is forming a committee and obtaining public input. Committee meetings are open to the public, but separate public meetings are also held. • There will be two public meetings; this is the first. • Another location to provide input is at www.yourfortworth.org for the mySidewalk survey tool. There are questions for residents' to answer about flooding within the City of Fort Worth. • This survey helps public education and awareness efforts and to gauge the public's knowledge on flooding and learn what concerns they have. The public input will assist in the development of the plan. • Residents can assist the City by providing comments on the plan as well as flooding concerns within the City. • There is a gap between insurance policies and structures within the floodplain is of concern.	FNI
8.	Resident Question: Why doesn't the city raise taxes to cover the cost of the insurance when they approved the usage for building in the floodplain?	Resident/City

ITEM	DESCRIPTION	PRESENTER
	Resident Concern: The neighborhood floods but not located within the floodplain. City Response: Flood insurance is available to everyone in or out of the floodplain despite the circumstances. Many of the developments were approved prior to 1980 when the City had lesser floodplain development standards. Current developments must go through a permitting process prior to developing in the floodplain. Older parts of the City may still have a flood risk with or without the floodplain.	
9.	Resident Question: Could the city council go through each district and each of the neighborhoods to get feedback from each of districts related to flooding? City Response: The City is looking for any way it can to spread the word about flooding concerns and the floodplain management plan. Council is an important part of that and this comment will be taken into consideration.	Resident/City
10.	Resident Question: How will this plan affect insurance rates and when? FNI: This plan is part of improving overall CRS score. Once the City performs this and a few other tasks, they will attempt to improve the CRS number thereby reducing flood insurance rates. This plan must be adopted by Council and approved by FEMA.	
11.	Resident Question: How much has been budgeted and how much is used each year for stormwater improvements? City Response: The city has a $30 million operating budget, one-third of which goes to operation and maintenance. It also has $3-5 million set aside for capital projects and has to balance the budget between operations and maintenance as well as capital projects. The City estimates the need for billions of dollars in storm drain improvements and capital projects.	Resident/City
12.	There were several comments from residents about how the $30 million budget is not adequate funding to address the city's needs. The residents feel that developers and builders should be made to bear more of the responsibility for the flooding and runoff created by their developments and structures. There were also several comments to raise the stormwater utility fee to receive funding for flooding improvements. City Response: This plan will help prioritize projects to work within the current budget.	Resident
13.	A resident noticed a big wall of water running down the street near his home. The resident did not believe that $5 million would be	Resident

ITEM	DESCRIPTION	PRESENTER
	enough money to solve the neighborhood flooding issues, let alone the whole city.	
14.	Resident Question: Runoff victimizes citizens. The city needs to put the burden back on the developer to put in culverts or take measures to prevent increasing runoff. What is the policy for development in a floodplain area? City Response: The measures put in place in 2006 have been successful, but that is relatively recent. In order to proceed with new development, developers are currently required to show an engineering study proving they will not make flood prone areas worse. Developers do not have to improve the flood prone areas, but do have to show their impacts to the community. Older developments were not subject to the same requirements. It is important to address your council in what policies the residents would like.	Resident/City
15.	Council Member District 5 Question: What is in place to help citizens who have experienced flooding? Several residents have been calling and asking if sand bags, etc. are available because they heard on the news that other cities provided sandbags to their residents. A different resident in attendance said that she was able to obtain some free sand bags from City of Fort Worth. City Response: Constituents should call the 817-392-8100 customer service line for help or to let the City know of issues.	Resident/City
16.	Resident Comment: The city should mail out information, such as the Runoff Rundown, with the water bills about emergency procedures so people know what to do to get help.	Resident
17.	Resident Question: What kind of studies were done to allow the River Trail development? City Response: Their permit is dated 1985 for that development. That development is all represented under one permit, but anything not covered under the previous permit will be subject to the new permit regulations.	Resident/City
18.	Resident Question: Would it be possible for someone in your department to spend 4 hours a day to go take a look at some of these areas? City Response: The City has limited resources and staff to perform site visits every day; however, the City will respond to residents' concerns and do their best to assess flooding. The City knows about some areas experiencing flooding, but not all. The most help is to hear from residents. The comments gathered today and throughout	Resident/City

ITEM	DESCRIPTION	PRESENTER
	the plan will become a part of the plan to prioritize reducing the flood hazard in flooding areas. Also included in the plan is education to the public, looking at the development standards, and going out into the field.	
19.	Comment from the City: The feedback tonight helps the city make budget decisions and will help the city council know there are needs.	City
20.	Resident/business owner Comment: I operate an equestrian center on Randol Mill Road. The ditches are not being maintained. It's completely shut my business down. The drainpipe is completely inadequate and totally clogged. City Response: The city maintenance crew may break from their schedule to clear out clogged storm drains reported to the city.	Resident/City
21.	Resident Comment: The planning commission is reviewing development in the City. There are state laws limiting what can be required of developers. The commission is looking at permits and properties one at a time to try and make the best decisions on development approval.	Resident
22.	Resident Question: Sewage sat in a storm drain for a week. Are these ever drained? City Response: The stormwater department would have to contact the water/sewer department to determine what measures need to be taken to resolve that issue.	Resident/City
23.	Resident Comment: Flood Insurance is the only way to protect personal property.	Resident
24.	Resident Comment: Has the city considered mapping additional areas as floodplain, for example Arlington Heights? What is an estimated timeline of doing that? Where is the information showing where the locations of flood hazards outside the floodplain? Is flood insurance available from other agencies than FEMA? City Response: Arlington Heights as well as other flood prone areas have been studied extensively, and the City is working on how to share the information with the community without putting a larger flood insurance burden on homeowners. The City is attempting to balance the benefit of sharing floodplain information without increasing flood insurance rates, if possible. Flood insurance would be expensive through private carriers. FEMA is the only place that gives you the discount to give you lower premiums.	Resident/City
25.	Resident Question: $14-16 million is being requested by the Water Development Board. Is that being used for stormwater improvements?	Resident/City/ FNI

ITEM	DESCRIPTION	PRESENTER
	City Response: The floodplain department is currently not aware of the availability of that money to be used for stormwater purposes. Freese & Nichols: The Water Development Board has separate studies and budgets for floodplain management.	
26.	Resident Question: Is the City of Fort Worth going to address the TRV? The flooding of the past few days has shown that there are some instances where residents should not be close to the Trinity. The Trinity River Vision Project plans to take the levees down. People would be closer to the water. This is potentially dangerous. City Response: The city works with the Army Corps of Engineers as much as possible and TRWD and TRV closely to assist the community in making informed decisions.	Resident/City
27.	Resident Question: Is Federal funding available? A large lake should be constructed to hold all of the water. Fort Worth & Dallas came together to build an airport, why can't they come together to relieve the levee by building a big lake? City Response: It would take a regional effort to do something like that. The city would be willing to work with Dallas to see if there is a larger mitigation plan that could be implemented. Fort Worth participates in a program to reduce impacts to the Trinity River and cooperates with FEMA and the USACE to prevent causing problems downstream in Dallas.	Resident/City
28.	Resident Comment**:** Big money projects always seem leery. There would probably be a conflict of interest concerning the insurance companies. City Response: FEMA came in to mitigate the risk when all the insurance companies figured out that flood insurance does not make money; those companies lost a lot of money trying to insure flood damage.	Resident/City
29.	Resident Comment: It seems like the City always waits until there's a disaster to take action in reducing flood risk, like in 1949 when the city built the levee after the huge flood. City Response: The city knows it is a lot cheaper to mitigate and prevent than deal with a problem during or after a disaster. Mitigation options are considered where feasible.	Resident/City
30.	Resident Question: In my household, insurance has been a big concern lately. Is it state insurance or federal? City Response: Flood insurance is federal provided by FEMA, and is available wherever you live.	Resident/City

ITEM	DESCRIPTION	PRESENTER
31.	Resident Comment: My house flooded in 2004, so I have become very active. The city staff can't carry the political football on their own. The only way to make change is to make your voice heard. Get involved, make phone calls, and talk to council. Complaints used to go in a filing cabinet before. Now, there are records of complaints as well as flood maps and information available. Getting involved is the only way to make changes. The City staff is tied to its budget and can only improve within that level. The Stormwater Utility Fee was created and the City removed that money from the General Fund and created a new stormwater budget rather than adding to it.	Resident
32.	Resident: Tell your neighbors to get out and vote to make change. City: The stormwater department can move quicker and create change with more resident advocates.	Resident

Stormwater Mission: To protect people and property form harmful Stormwater Runoff.

MEETING MINUTES

PROJECT: 510 Floodplain Management Plan
NAME OF MEETING: Stakeholder Planning Group Meeting #2
RECORDED BY: Freese and Nichols, Inc.
DATE: August 4, 2015
LOCATION: Hazel Harvey Peace center for Neighborhoods
ATTENDEES:

City Staff	Committee Members	Other Attendees
Clair Davis – CFW SW	LaWayne Houser – Resident	John Morris – Resident
Cindy Robinson - CFW SW	Joe Waller – Resident	David Ludwig – Hope Church
Jennifer Dyke – CFW SW	Larry Langston – Resident	Jerry Roberts – Hope Church
Mary Hanna – CFW SW	Libby Willis – FWLNA	Ryan Hill – Shield Engineering
Juan Ortiz – CFW OEM	Joe Schneider – Hillwood	Travis Patton – Shield Engineering
Joel McElhany – CFW PACS	Mike Dellies - Dunaway	Ron Rogers, Velina Willis – OCG PR
Art Basher – CFW Legal	Mikel Wilkins - Verdunity	Scott Hubley, Katie Hogan – FNI

The following reflects our understanding of the items discussed during the subject meeting. If you do not notify us within five working days, we will assume that you are in agreement with our understanding.

ITEM	DESCRIPTION	PRESENTER
1.	Introductions of committee members and City Staff	All
2.	Clair and Scott gave a recap of the first committee meeting discussion and went over the agenda items.	Clair/Scott
3.	Clair mentioned that it is intended for the City to review this 510 plan annually with on-going committee participation.	Clair
4.	Scott gave an overview of the Step 4 Hazard Assessment section of the report. The committee provided the following feedback and comments regarding these sections: 1. Incorporate projections of future meteorological events and rainfall data based on changing climate. 2. Known hazards include transportation systems and lack of inlets. Work with TXDOT to improve these systems. 3. For future updates, it may be beneficial to revise the statistics based on more detailed information. 4. The data regarding buildings inside the floodplain were based on horizontal locations and not FFE. It may be beneficial to incorporate FFEs in these counts in the future. 5. It would be helpful to be more specific as to the locations of the Severe Repetitive Loss Structures. City Response: These locations are protected so limited information can be released. 6. Incorporate possible earthquake impacts to dams and levees. TRWD did look at Eagle Mountain dam and the impact on earthquakes. There is some information available and TCEQ as well as USACE perform regular inspections.	All
5.	Scott summarized the Step 5 Assess the Problem to the committee. The Committee reviewed the report section and provided the following comments:	All

	1. During the Hurricanes Katrina and Rita in 2005, the City of Fort Worth processed 35,000 people to temporary shelters and apartment complexes. At a time there were less than 3000 people in shelters. There was a 6 week period from the first person to arrive for shelter to the last person who left the shelter to a temporary shelter or apartment. The City has a target of providing shelter for 3,000-4,000 people at a time and moving to temporary homes as soon as possible. If an event were to happen in the City, coordination with neighboring communities is also a possibility if shelter is needed. 2. It should be noted that shelter is provided after a storm event has happened, not during a storm because of other hazards that frequently occur during a storm (hail, tornadoes). 3. There may be an impact to naming specific businesses that do not have flood insurance in the report. It would be better to generalize the type of business rather than specifically stating their names. 4. It would be beneficial to have a targeted outreach program to promote flood insurance. The Committee could potentially assist with this program. 5. Determine the reason for City-owned buildings not having insurance. Clair explained that the city is self-insured so many buildings may not be insured through NFIP but are insured at the City. In particular, the committee questioned the Cowtown Coliseum and whether it needs insurance because it is a historic structure.	
6.	The goals for Step 6 were revisited and the Committee did not have comments.	Scott/All
7.	Steps 7 and 8 were discussed together to brainstorm possible mitigation actions the City could do to reduce flood hazard impacts. The Committee provided suggestions on each type of mitigation activity. Refer to draft action plan for additional information. Blue text indicates input received at the meeting.	All

ACTION ITEMS			
WHAT	**WHO**	**WHEN**	**STATUS**
1. Develop Mitigation Action Plan	FNI	Aug-Sep	On Going
2. Hold 3rd Committee Meeting	City/FNI	Late Sep	Pending
3. Hold 2nd Public Meeting	City/FNI	Late Sep	Pending

Stormwater Mission: To protect people and property from harmful Stormwater Runoff.

MEETING MINUTES

PROJECT:	Fort Worth Floodplain Management Plan
NAME OF MEETING:	Public Meeting #2
RECORDED BY:	Scott Hubley, FNI, Katie Hogan, FNI, Ron Rogers, OCG
DATE:	9/28/2015
LOCATION:	Hazel Harvey Peace Center for Neighborhoods
ATTENDEES:	City of Fort Worth Staff FNI personnel OCG personnel 6 Residents

The following reflects our understanding of the items discussed during the subject meeting. If you do not notify us within five working days, we will assume that you are in agreement with our understanding.

ITEM	DESCRIPTION	PRESENTER
1.	**Clair Davis**, P.E., CFM introduced himself as the Floodplain Administrator for the Stormwater Management Division of the City of Fort Worth. He also introduced **Scott Hubley**, P.E., CFM, and project manager for the development of the floodplain plan with Freese & Nichols, Inc. Purpose of the meeting: Present a draft of the Fort Worth Floodplain Management Plan to the public and allow them to give feedback, especially for the Mitigation Action Plan.	City
2.	Scott Hubley gave a review of information covered in Public Meeting #1. The Following topics where covered: • Overview of NFIP • Purpose of CRS and how FMP improves CRS score • Stormwater Utility Fee overview and budget breakdown • Steps 1-6 of the FMP, including HAZUS Analysis • A lot of flooding problems in Fort Worth are outside the FEMA Floodplain	FNI
3.	Resident Question: 2009 data used for HAZUS analysis is old. Is it possible to keep data more current? City Response: 2009 data is best available. Updating data more frequently could be an action item in the Mitigation Action Plan	City/Resident
4.	Resident Question: Sewer treatment plant has a berm that is not needed. Can this be converted to a floodplain storage area? City Response: The treatment plant is part of the Water Department. The Stormwater group can coordinate future plans with the Water department at this location.	City
5.	Resident Question: Have natural areas been identified? There is oil drilling happening in the USACE mitigation banks. There should be more regulation on natural areas.	City

ITEM	DESCRIPTION	PRESENTER
	Different Resident: There is a concrete plant that has been built in the floodplain in without a permit. Builders should have the same requirements as everyone else. City Response: Increasing the city's enforcement capabilities could be a possible action. Resident Comment: There is too much talk and not enough action. City Response: A plan is a way start action.	
6.	Resident Comment: During rainstorms there is fast-moving water a half mile away from the Trinity River near Randol Mill and Precinct Line. Are there any devices measuring the flow of water there? City Response: No, we don't have any devices in that location.	City/Resident
7.	Resident Comment: When there are floods, the barriers are placed too close to the flood. People turn around a drive on the grass instead of turning around just on road. The grass gets torn up. Also, the flashing warning signs don't work. City Response: The non-functioning lights were noted. City will send out field workers to check them. The city has a team that will respond upon request. They also have check list of preventative actions they take when a large rain event is forecasted.	City/Resident
8.	Resident Comment: Why does the City always wait for a tragedy to happen before taking action? The city only fixed the potholes on Precinct after a car got stuck and was totaled. Then they didn't even fix the potholes properly. City Response: Our field team goes around and checks for problems. If you call, they will come.	Resident/City
9.	City Comment: The sandbag program is not widely publicized because the city is afraid that residents will try to drive through the dangerous flood waters in effort to pick up sand bags.	Resident/City
10.	Resident Comment: After a flood in the past, there were many dead animals on her property. The city would not come to help clean them up when she called. City Response: Write down list of properties that should be investigated, the city can incorporate specific areas into studies if they know about them.	
11.	Resident Comment: I saw a six-wheeled amphibious vehicle being used by the city during the recent floods. Can this be used to study areas during the floods?	

ITEM	DESCRIPTION	PRESENTER
	City Response: City staff is not aware of such a vehicle. If the Water Department owns it, the Stormwater Department can coordinate to potentially use it during the floods.	
12.	Resident Question: I thought there would be a bridge over Sycamore Creek. Instead it is a low water crossing. The water gets backed up because of the new structure. There is more flooding on Trimble Drive since the new structure was put in. If some trash gets built up, my property will flood. City Response: The newest models were used for the low water crossing. There will be overtopping during storms. FNI: Low water crossings have a more significant impact with smaller storm events, but as the water level rises with heavy storm events, the water will flow over the crossing and the impacts are much less significant. City Response: An appointment was made to meet the resident at her property and look over the area.	
13.	Resident Question: Is the city collecting new topographic data? City Response: LIDAR and survey data are used for designs and studies Resident: The city needs more data and more development restrictions	

Appendix C

Detailed Tables

Table C-1: Summary of Comment Cards from Public Meeting #1

Resident	Do you live in a floodplain?	Do you have flood insurance?	Has your property flooded before?	Do you know of any flood prone areas that you would like to make the city aware of?	Which type of flood risk mitigation activities would you support?
1	Unsure	No	Yes	Storm Drains on Camelot and Royster	Preventive activities Public information activities
2	Yes	No	Yes	Resident's address	Preventive activites Natural floodplain function protection activites Property protection and mitigation activites Emergency service activites Public information activities
3	Yes	No	No	Trinity Blvd and Norwood / Precinct and Randol Mill	Preventive activites Structural
4	Unsure	No	Yes	District 6 Panther Heights	Preventive activites Natural floodplain function protection activites Emergency service activites Public information activities
5	No	Yes	Yes	Previous address on Carleton Avenue	Preventive activites Natural floodplain function protection activites Property protection and mitigation activites Emergency service activites Public information activities
6	No	No	No	Precinct line and Trinity Blvd development	Preventive activites Natural floodplain function protection activites
7	Yes	Yes	Yes	Southeast areas of Trinity Blvd	Preventive activites Natural floodplain function protection activites Property protection and mitigation activites Public information activities
8	Yes	Yes	Yes	820 Trinity Blvd Precinct Line/Randol Mill	Preventive activites Natural floodplain function protection activites Property protection and mitigation activites Emergency service activites Public information activities

Resident	Do you live in a floodplain?	Do you have flood insurance?	Has your property flooded before?	Do you know of any flood prone areas that you would like to make the city aware of?	Which type of flood risk mitigation activities would you support?
9	No	No	No	No	Preventive activites Emergency service activites Public information activities Structural projects
10	No	No	No	No	Preventive activites Natural floodplain function protection activites Emergency service activites Public information activities
11	Unsure	No	No	No	Preventive activites Natural floodplain function protection activites Property protection and mitigation activites Emergency service activites Public information activities
12	Unsure	Unsure	Unsure	No	
13	No	No	No	No	
14	No	Yes	Yes	Yard and domocile was completely covered with water	Property protection and mitigation activities Emergency service activities
15	No	Unsure	Yes	Yard was completely underwater with no drainage	
16	No	No	Yes		Preventive activities Public information activities
17	Unsure	No	No	Intersection of S. Adams & Rosedale / Henderson & Rosedale	Preventive activities Natural floodplain function protection activities

Resident	Do you live in a floodplain?	Do you have flood insurance?	Has your property flooded before?	Do you know of any flood prone areas that you would like to make the city aware of?	Which type of flood risk mitigation activities would you support?
18	No	No	No	Garden Acres 11001 Brownfield Area	
19	No	No	No	Arlington Heights / West of Hulen	Preventive activities

Table C-2: Stream Velocities

Stream	Average (fps)	Max (fps)	Min (fps)
Big Bear Creek	4.6	7.4	2.3
BB-1	4.9	5.4	4.5
BB-2	5.7	7	4.5
BB-3	6.4	9.2	3.6
BB-5	4.2	4.3	4.1
BB-6	7.2	13.9	3.3
BB-8	5.6	8.6	3.6
BB-9	3.9	5	2.2
BB-10	4.1	6.1	2.7
BB-11	6.0	9.1	3.7
BB-12	3.9	6.7	1.8
Big Fossil Creek	5.2	10.5	1.2
BFC-1	7.0	15.7	3.1
BFC-2	6.8	9.8	2.1
BFC-2A	4.9	6	3.7
BFC-3	5.2	7.4	3.8
BFC-4	3.5	4.6	1.4
BFC-4A	3.5	5.2	2
BFC-4B	8.5	8.5	8.5
BFC-5	4.6	6.3	1.6
BFC-5A	5.0	6.3	3.6
BFC-5B	3.0	4.2	2.2
BFC-6	5.5	6	4.7
BFC-7	6.9	8.6	5.1
Buffalo Creek	3.9	5.3	2.6
Calloway Branch	7.3	15.4	4.1
CB-1	7.8	9	6.6
CB-2	7.4	9.1	5
Clear Fork Trinity	6.2	7.7	4.3
CF-2	4.5	7.6	0.6
CF-3	7.2	11.9	2.4
CF-3A	8.1	10.1	6
CF-3B	6.3	8.3	4.4
CF-3C	9.0	9.4	8.6
CF-4	10.7	14.5	5.3
CF-4A	6.1	10	4
CF-4A Diversion	4.6	6.9	2.6
CF-5	6.6	12.6	1.5
CF-6	7.2	8.8	4.8

Stream	Average (fps)	Max (fps)	Min (fps)
Cottonwood Branch	3.2	4.4	2.6
Cottonwood Creek1	6.2	11.9	2.4
Cottonwood Creek2	4.2	8.5	2
Deer Creek	5.8	9.5	2
North Branch of Deer Creek	4.3	6.4	2
Northwest Branch of Deer Creek	5.9	7.3	4.6
North Fork of Deer Creek	3.7	4.8	1.7
South Fork of Deer Creek	5.0	7.3	2
South Fork of North Branch of Deer Creek	6.6	7.9	4.4
Dutch Branch	7.2	8	6.6
Elm Branch	4.2	6.2	3.3
Farmers Branch	5.6	9.1	2.4
FB-1	5.4	7.3	3.5
Henrietta Creek	5.1	6.2	3.1
HEN-1	4.1	5	3.2
HEN-2	3.9	5.3	3
HEN-2A	4.5	5.2	3.2
Kings Branch	6.4	9.7	2.4
Little Fossil Creek	6.2	10.5	1.9
LFC-1	6.3	7.5	4.9
LFC-2	5.7	8.1	3.6
Live Oak Creek	6.5	8.4	3.5
Marine Creek	6.3	10.6	1
MC-1	6.3	8	3.6
MC-2	4.7	4.7	4.7
Mary's Creek	6.3	8.6	3.6
MSC-1	6.1	7.6	3.6
MSC-1A	8.1	13	3.2
MSC-2	4.3	5.9	2.4
MSC-2A	6.0	6	6
Silver Creek	3.8	3.8	3.8
South Marys Creek	7.5	9.1	5.1
Sulphur Branch	10.3	22.7	5.7
SB-1	5.9	14.4	1
Sycamore Creek	6.2	10.7	2.1
SC-1	5.8	9.3	4.4
SC-2	3.2	6.1	0.7
SC-3	7.4	8.9	6.4
SC-4	7.3	7.3	7.3
SC-5	6.8	15.6	2.4

Stream	Average (fps)	Max (fps)	Min (fps)
SC-6	3.9	7.1	0.9
SC-7	6.7	10.3	3.2
Valley View Branch	6.1	9.7	3.1
VVB-1	5.7	9	1.5
Village Creek	4.0	10.3	1.9
VC(A)-1	3.9	5.7	1.9
VC(A)-2	8.9	12.5	6.3
VC-1	5.4	8.7	3.1
VC-2	5.5	8.5	3.8
VC-2A	8.9	10.3	7.4
VC-3	7.0	7.5	5.7
VC-4	4.9	5.7	3.4
VC-4A	5.8	6.9	5
VC-5	4.3	5.1	2.9
VC-6	3.4	4.6	2.4
VC-7	4.2	6.2	2.1
Walker Branch	5.5	12	1
WB-1	4.6	5.3	3.7
Walnut Creek 1	4.0	4.3	3.5
Walnut Creek 2	7.7	11.1	4.6
Walnut Creek 3	4.3	10.1	2.8
West Fork Trinity	2.6	5.2	0.9
WF(A)-1	5.4	9.7	3.7
WF(A)-2	7.5	11.7	5
WF-1	5.1	9.1	3.4
WF-1A	3.6	4.5	2.9
WF-1B	6.6	8.3	4.5
WF-2	7.6	9.3	5
WF-2A	10.1	10.1	10.1
WF-3	5.9	7.8	3.5
WF-4	5.2	7.8	2.7
WF-5	5.1	7.7	2.9
WF-7	4.6	6	3
WF-7A	5.2	6.9	3.4
WF-7B	6.0	7.4	4.5
WF-9	5.2	6.7	2.5
WF-10	9.4	15	6.4
WF-10A	5.9	7.3	4.9
WF-11	5.7	8.9	3
White's Branch	4.6	5.6	3.3

Stream	Average (fps)	Max (fps)	Min (fps)
WB-1	3.7	4.9	3
Wildcat Branch	4.5	8	2.6
WC-1	5.6	8.1	3.5

Table C-3: Completed Open Channel Studies

Zoo Creek Master Plan	The purpose of this study was to provide a better understanding of Zoo Creek's current geomorphic state, identify potential long-term solutions to address the capacity, ongoing erosion and deposition issues along the creek, and identify short-term solutions that provide a reasonable alternative to address nuisance flooding during more frequent storm events.
Lebow Creek Master Plan	The purpose of this study was to identify ways to remove roadways and property from the floodplain, create linear open space and trails, and encourage economic redevelopment in the area north of downtown. The plan calls for floodprone property buyouts, elimination of hazardous low-water crossings, bridge reconstruction, regional detention and channel capacity improvements.
Como Creek Master Plan	The purpose of this study was to develop a comprehensive master drainage plan for the Como Creek watershed which drains generally south, crossing under Vickery Boulevard and the Union Pacific Railroad before discharging into the Clear Fork Trinity River.
Warner Channel FEMA Floodplain Re-Mapping Study	The pupose of this study was to develop a detailed H&H model and WSEL in Warner Creek located in west Fort Worth approximately 1 mile south of I-30 and identify stormwater improvements.
Leslie Creek Watershed Master Plan	The purpose of this study was to analyze existing H&H conditions and develop a set of alternatives to improve drainage in the Leslie Creek watershed southwest of downtown to reduce flood impacts to existing structures. This stream has never been studied in detail nor mapped by FEMA.
Woodhaven Creek Master Plan	The purpose of this study was to evaluate flooding within the Woodhaven Creek Watershed (WF-2A) on the east side of Fort Worth to determine the current extent of the 100-year floodplain, identify floodplain impacted structures, and develop alternatives to reduce flood impact.
Royal Creek Master Plan	The purpose of this study was to develop peak flows and water surface profiles and develop new inudndation mapping to identify flooding issues along Royal Creek in southwest Fort Worth, north of the Benbrook city limits.

Eastland Creek Master Plan	The purpose of this study was to assess the existing conditions of stream VC-1 in eastern Fort Worth and develop detailed H&H models to identify a master plan for stormwater improvements.
Menefee Creek Master Plan	The purpose of this study was to assess the existing conditions of WF-5B in northwest Fort Worth and perform H&H analyses to develop a master plan of improvements.
Prairie Dog Creek Master Plan	The purpose of this study was to analyze and evaluate the existing floodplain conditions of Prairie Dog Creek (VC-2) in the southeastern part of Fort Worth and to assess the existing conditions of the creek and develop a master plan for improvements.
South Mary's Creek Master Plan (Lost Creek)	The purpose this study was to perform detailed H&H analyses of the South Mary's Creek watershed in order to better define the 100-year floodplain limits and elevations along the stream reach between the F Bar Trail and Linkhill Drive in west Fort Worth.
Stream SC-7	The purpose of this study was to analyze and evaluate the existing floodplain conditions of Sycamore Creek Tributary 7 (SC-7) in the southwestern part of Fort Worth and to assess the existing conditions of the creek and develop a master plan for improvements.
Lower Edgecliff Master Plan	The purpose of this study was to analyze and evaluate the existing floodplain conditions of Edgecliff Branch in the southwestern part of Fort Worth and to assess the existing conditions of the creek and develop a master plan for improvements.
Plantation Creeks Master Plan	The purpose of this study was to develop detailed H&H models and inundation mapping and identify flooding issues along the Plantation Creeks, tributaries of Mary's Creek located in southwest Fort Worth, north of the Benbrook city limits.
Comanche Creek Master Plan	The purpose of this study was to analyze portions of the Comanche Creek Watershed to determine opportunities for regional detention that could be constructed as development occurs within the watershed. The Comanche Creek Watershed is located north of IH-820, west of SH 199 and south of Charbonneau Road near the city limits of Lake Worth and Fort Worth.

Table C-4: Open Channel Studies in Progress

Lower Mary's Creek Master Plan	This is a joint study between the City of Benbrook and Fort Worth to correct the current effective FEMA model for Mary's Creek.
Upper Willow Lake Channel Master Plan	This study is performed to provide a detailed model and to accurately map the floodplain. The master plan will identify alternatives to protect homes and prevent roadway flooding. The study area is located in the southwest portion of the City near the intersection of Hulen Street and IH 20.
Dunbar Creek Master Plan	This study better defines the existing and ultimate floodplains and identifies alternatives necessary to protect homes and prevent roadway flooding in the Dunbar Creek area, which drains into Lake Arlington.
Wildcat Branch Master Plan	This study better defines the existing and ultimate floodplains and identifies alternatives necessary to protect homes and prevent roadway flooding in the Wildcat Brach area, which drains into Lake Arlington.
Greenbriar Creek Master Plan	This study is performed to better understand existing flood risks and to develop a drainage master plan to reduce flood risks. This includes studying open channel flooding from Greenbriar Creek as well as overland flooding from existing storm drain systems. The study area is north of I-20/I-820, west of I-35W, south of Seminary Drive, and east of Stadium Dr.
Marlborough/Xavier/Country Day Channels Re-Mapping Study	This study is performed to remap the effective FEMA floodplain to better identify flood risk in 3 different southwest Fort Worth locations.
Summerfields Creek Master Plan	This study is performed to refine existing and ultimate condition floodplains and identify alternatives to reduce structure and roadway flooding. The study area is in north Fort Worth near Beach and Basswood Blvd.
Glenwood Creek Master Plan	This study is performed to better define the effective FEMA floodplain and identify alternatives to improve drainage and reduce flood impacts to existing structures and roadways. Glenwood Creek is a tributary of Sycamore Creek located southeast of downtown.
Cottonwood Creek Master Plan	The study is being performed in far east Fort Worth to remap the FEMA effective floodplains to better define flood risk. A master plan of stormwater improvements to reduce flooding to homes and roadways will be produced. Data from this study will be used by the City Park's Department to identify ways to reduce the erosion problem in Sandy Lane Park.

Overton Creeks Master Plan	This study is performed to refine the FEMA effective floodplains in the Overton Creek area including Sarita and Inwood channels in southwest Fort Worth. Alternatives to reduce home and roadway flooding will be identified.
Ludelle Channel Master Plan	This study is to assess the existing conditions of the Ludelle Creek watershed and to develop a master plan of improvements aimed at mitigating flood damages to structures and roadways. The study area is east of 287 and south of I-30.
Seybold Creek Master Plan	The purpose of this study is to assess the existing conditions of Seybold Creek, a tributary of Big Bear Creek, and to develop a master plan of improvements aimed at mitigating flood damages to structures and roadways. The study area is in north Fort Worth east of I-35 and north of FM 1709.
Lake Country Estates Drainage Master Plan	This study provides an understanding of the flooding situation for the Lake Country Estates subdivision, which is a residential community located along the southeast portion of Eagle Mountain Lake. The study develops recommendations to alleviate flooding and identifies a master plan for drainage improvements.
Stream MSC2	This study is to analyze the existing and fully developed flooding conditions along Stream MSC-1, MSC-2, and MSC-2A. The study area is west of 820 and south of I-30 including All Saints Episcopal School and the Linda Vista Estates residential area.
Tony's Creek Master Plan	The study is to analyze and evaluate the existing floodplain conditions of Tony's Creek and to address 29th Street culvert improvements and the Stockyards detention basin. The study also evaluates flooding in the Northwest Diamond Hills neighborhood and identifies alternatives to mitigate flood damages.
Big Bear Creek Master Plan	The purpose of this study is to assess the existing and future conditions of Big Bear Creek watershed in north Fort Worth and develop a master plan of improvements aimed at mitigating flood damages to structures and roadway inundation.
Little Fossil Creek Floodplain Study	This study is to develop updated flood hazard mapping for Little Fossil Creek and its tributary in northeast Fort Worth. The study will also identify potential solutions to reduce flooding.
Dry Branch	The purpose of this study is to remap the FEMA effective floodplain due to stormwater improvements and develop effective, affordable and acceptable alternatives to provide flood reduction to the historic homes in the Carter-Riverside neighborhood west of Beach and north of Belknap.

Table C-5: Completed Storm Drain Improvement Studies

Henderson Street Storm Drain Watershed	The purpose of this study was to evaluate flooding risk, the physical condition of the system, and system capacity and identify alternatives for stormwater improvements in west central downtown.
Eastern Hills Watershed Planning Study	The purpose of this study was to address chronic flooding problems caused by severely undersized drainage systems in the Eastern Hills neighborhood in east Fort Worth and identify stormwater improvements.
East Central Business District Watershed Planning Study	The purpose of this study was to perform a 2D analysis to identify and document system deficiencies and develop recommendations for stormwater improvements.
Lake Crest Drainage Master Plan	The purpose of this study was to perform H&H computations, evaulate options, and present a recommendation for improvement in Lake Crest Estates in northwest Fort Worth.
Bonnie Brae and Carter-Riverside Neighborhoods	The purpose of this study was to identify drainage deficiencies and propose storm sewer system improvements in the Bonnie Brae and Carter-Riverside neighborhoods located northeast of downtown.
Greenfield Acres Drainage Master Plan	The purpose of this study was to perform an analysis to present recommendations for improving the existing storm drainage system in the Greenfield Acres Neighborhood north of Jacksboro Highway and Loop 820.
Hallmark Drainage Master Plan	The purpose of this study was to determine drainage deficiencies in the neighborhood located east of Sycamore Creek and west of I-35 and develop a master plan for future drainage improvements.
Edgecliff Tributaries Master Plan	The purpose of this study was to perform H&H analysis for tributary EB-1 and develop a master plan for improvements to protect homes and prevent roadway flooding during the 100-year storm.

Stream WF-1 Master Plan (Randol Mill culverts)	The purpose of this study was to perform detailed H&H analyses to better define the 100-year floodplain and WSELs along the stream reach between the West Fork Trinity River and I-30 in east Fort Worth and develop a set of improvement alternatives to minimize flood impacts to homes and buildings.
Burton Hill Trinity Trails Neighborhood Drainage Study	The purpose of this study was to provide an analysis of the existing flooding problems within the Burton Hill neighborhood located north of I-30 and Camp Bowie and offer recommendations for storm drain improvements.

Table C-6: Storm Drain Improvement Studies in Progress

Garden Acres Drainage Master Plan	This study will develop a master drainage plan for the Garden Acres subdivision, which was annexed in south Fort Worth. The area has inadequate drainage infrastructure. The plan includes phasing alternatives and investigation of the feasibility of installing drainage improvements.
Broadmoor Drainage Master Plan	This is a master drainage plan for the Broadmoor neighborhood south of I-30 near Altamere Road. This study assesses flooding from both an open channel and the storm drain pipe system. The proposed study delineates the existing floodplain and identifies needed drainage improvements necessary to protect homes and prevent roadway flooding during the 100-year storm.
Lake Arlington West Shore Drainage Master Plan	The study assesses drainage deficiencies along the western shore of Lake Arlington. The master plan will identify alternatives to reduce existing neighborhood flooding and guide future economic development.
Ridglea Creek and Luther Creek Master Plan	This study is performed in coordination with the Edwards Ranch development to better define the existing flood problems by evaluating Ridglea Creek and Luther Creek and the undersized storm drain system to identify drainage improvements. The study area includes Ridglea Country Club and the area between Camp Bowie and Vickery.
Central Arlington Heights Watershed Planning Study	The purpose of this study is to address the chronic flood hazard and build on prior study efforts to develop effective, acceptable, and affordable solutions to reduce flooding to homes and roadways in the area near I-30 and Hulen.
McCart-Berry Flood Mitigation Study	The study is being performed to further investigate alternatives to reduce flooding in the Forest-Park-Berry and TCU area south of the Fort Worth Zoo. This study is being performed in collaboration with the Planning Department's Berry/University Urban Village study to encourage economic development by planning for future drainage infrastructure needs, reduce existing flooding to structure and roadways and increase public safety. Effective, affordable and acceptable mitigation solutions will be identified incorporating stakeholder and public input.

Near Southside Regional Detention Study	The purpose of this study is to define flooding south of downtown and identify effective, affordable and acceptable stormwater and multi-use alternatives that provide for future drainage infrastructure needs by accommodating and encouraging economic development, reducing existing flooding and increasing level of service to structures and roadways, and increasing public safety. The study will incorporate public input through a stakeholder group comprised of Fort Worth South Inc., developers, businesses and residents.
Central Meadowbrook Neighborhood Drainage Study	Study to analyze both storm drain pipes and an open channel to identify an affordable, acceptable, and effective solution that reduces flooding and encourages economic development. The study area is located between I-30 and Meadowbrook, east of Oakland Blvd.
South Hemphill Heights Neighborhood Drainage Study	Study to evaluate flood risk and develop acceptable, affordable and effective mitigation strategies to reduce structure and roadway flooding and encourage economic development west of I-35 between Berry St. and Biddison St.
Near West Side	Phase one of this study will better define the existing and ultimate condition floodplain west of downtown. Phase two will identify effective, affordable and acceptable stormwater and multi-use alternatives that provide for future drainage infrastructure needs by accommodating and encouraging economic development, reduce existing flooding and increase level of service to structures and roadways, and increase public safety. The study will incorporate public input through a stakeholder group comprised of developers, businesses and residents.

Table C-7: Completed Stormwater Capital Improvement Projects

00085 - Briahaven-Fieldcrest - Drainage Improvements	This project enlarged and extended the undersized storm drain system along Briarhaven to reduce home flooding.
00086 - Robin-Denver Storm Drain Reconstruction, Major Drainage Rehabilitation	This project replaced a structurally deficient storm drain system on Lagonda Street from east of Northside Park to Gould Avenue.
00087 - Lost Creek Phase 2, Drainage Improvement	This project constructed major drainage improvements to reduce flooding to homes on Lost Creek and one portion on Powderhorn in Westpoint, Blue Creek Drive, and Ben Creek Court.
00088 - Morningside Neighborhood Drainage Improvements	This project constructed major drainage improvements to reduce home flooding in the Morningside Park area from East Cantey Street between Mississippi Avenue and New York Avenue; Mississippi Avenue from Baker Street to East Cantey Street; New York Avenue between East Cantey Street and Judd Street.
00089 - Kellis May	This project reduces home, church and street flooding by construction of an underground drainage system in Kellis Street from May Street, easterly to a storm drain culvert located on Union Pacific Railroad right-of-way.
00090 - Southland Terrace Drainage Improvement	This project reduces home and street flooding by constructing major drainage improvements where none existed on the Southern part of Cole Street and Cole Court discharging flow into Sycamore Creek.
00092 - Ryan Southeast Drainage Improvements	This project reduces flooding to homes and on Riverside Drive by installation of a storm drain system on Cantey Street from Yuma Avenue to Riverside Drive, Riverside Drive from Cantey Street to Colvin Avenue and Judd Street from Riverside Drive to Cobb Park.
00093 - Harlanwood Drive at Overton Park West Drainage Improvements	This project reduces street flooding in front of Tanglewood Elementary School by adding inlets to the intersection of Harlanwood Drive at Overton Park West.
00093 - Woodway-Wedgway Drainage Improvements	This project reduces home flooding by adding inlets on Wedgway.
00093 - 2008 Teakwood Trace Drainage Improvements	This project reduces home flooding by adding inlets on Teakwood Trace.
00093 - Kensington Drainage Improvements	This project reduces home flooding by adding inlets on Kensington.
00093 - Chapin-Guadalupe Drainage Improvements	This project reduces home flooding by adding inlets on Chapin and Guadalupe.
00093 - 3436 Clayton Road East Drainage Improvements	This project reduces home flooding by adding an inlet on Clayton Road East.
00093 - Fairway Dr. Drainage Improvements	This project reduces home flooding by adding an inlet on Fairway Drive.
00094 - Trail Drivers Park Storm Drain Improvements	This project replaced and upsized a collapsed storm drain pipe in Trail Drivers Park (Schwartz Ave at NE 28th).

00094 - Minor Misc. Storm Drain Improvements at Enderly Place and Park Place	This project reduces home flooding on Enderly Place and Park Place by constructing a storm drain system on Enderly Place, West Allen Ave and Park Place.
00094 - Minor Misc. Storm Drain Improvements on Havenwood Lane	This project reduces home and property flooding by adding storm drain pipe and inlets on Havenwood Lane.
00096 - Minor Misc. Channel Improvements - Arrowwood Channel	This project reduced erosion by stabilizing the banks of Arrowwood Channel from Debbie Street to 200 feet northeast.
00096 - Minor Misc. Channel Improvements -Mercado Channel	This project improved the capacity of Mercado Channel and provided erosion control from Northeast 20th Street to 250 feet northeast.
00096 - Minor Misc. Channel Improvements - Cottonwood Creek	This project reduced erosion by stabilizing the banks of Cottonwood Creek from Morrison Drive to Cooks Lane.
00097 - Minor Misc. Structural Improvements - Branch of Summerfield Channel	This project constructed a maintenance access ramp on a branch of Summerfield Channel near River Birch and Waswing.
00097 - Minor Misc. Structural Improvements - Luther Channel	This project reconstructed a portion of concrete channel and constructed a maintenance access ramp on Luther Channel near Ridglea Crest Addition.
00097 - Minor Misc. Structural Improvements - Colonial Channel	This project constructed maintenance access ramp on Colonial Channel from Simondale Drive to Bellaire Drive.
00097 - Minor Misc. Structural Improvements - Chaddybrook Ramps	This project constructed maintenance access ramp on Smithfield Creek between Chadybrook Lane and Brittany Place.
00098 - Minor Misc. Culvert Improvements - Glen Garden Drive	This project replaced and upsized a structurally deficient culvert on Glen Garden Drive.
00098 - Minor Misc. Culvert Improvements - Truman	This project reduced maintenance problems by extending storm drain box culvert on Truman and eliminating the open channel.
00098 - Minor Misc. Culvert Improvements - Williams Road near Norman	This project reduced maintenance problems by replacing earthen channel with a concrete lined channel at the Williams Road Storm Drain Extension.
00100 - 9700 Trinity Boulevard Culvert Improvements	This project reduces street flooding by replacing undersized box culverts on Trinity Blvd. over Bell Textron Channel.
00138 - East Rosedale at Mansfield & RR	This project reduces home and street flooding by improving culverts with TxDOT at Glenwood Creek (SC-2).
00142 - East Rosedale	This project reduces home and business flooding by extending the E. Rosedale bridge length over Sycamore Creek.
00143 - Harley Ave - Street Reconstruction	This project significantly upsized the storm drain system to reduce home and street flooding in coordination with a street project to relocate Harley Avenue for development.
00181 - Vera Cruz St. / Lebow Watershed Improvements	This project closed hazardous low water crossings at Oscar and 32nd Street as a part of the Lebow Channel Watershed 2004 CIP project.

00441 - Decatur Ave. Drainage Improvements	This project involved increasing the capacity of the existing storm drain system on Decatur Avenue from Parsons to Upper Lebow Creek by adding culvert and storm drain improvements in conjunction with a street reconstruction project.
00444 - Westcreek Drive East and West	This project reduces home and hazardous street flooding by increasing the capacity of the culvert and adding inlets on Westcreek Drive from IH 20 north to Bilglade.
00445 - Harper Street Drainage Improvements.	This project reduces home flooding by adding a storm drain system on Harper which included inlets and outlet pipe structure.
00446 - Spindle Tree Lane	This project reduces home and street flooding by increasing the capacity of the existing storm drain system on Spindle Tree Lane from Buttonwood to Pepperbush by adding inlets, increasing pipe size, and installation of a relief line.
00451 - Arlington Heights Street Reconstruction including Byers, Dexter, Dorothy, Lafayette, etc.	In coordination with a street reconstruction project, this project increased the capacity of the existing storm drain system on Dexter and Dorothy by adding additional inlets.
00474 - Linda Lane - Major Drainage	This project reduces home flooding by upsizing the storm drain system, in coordination with water and sewer improvements, in Linda Lane including South Riverside Drive. and Glen Eden Drive.
00474 -Oakridge Terrace - Major Drainage	This project reduces home flooding by constructing new and upgraded storm drain systems, in coordination with water and sewer improvements, in Oakridge Terrace including East Broadus Street, Sahara Place, Berke Road and within Carter Park.
00475 - Butler-McClure Culvert Improvements	This project removed a hazardous roadway crossing on Butler and McClure Streets due to the undersized culverts. Project included the construction of multiple box culverts, a bypass channel on the south side of Butler, replacement of water mains on Butler and McClure, relocation of sewer mains, and elevating both streets in the intersection.
00477 - East Harvey Storm Drain Reconstruction	This project reduces structural failure by constructing a larger storm drain within easements between Davis and East Harvey and between East Harvey and Powell, and constructing new inlets and storm drains at Powell, Davis, and East Harvey.
00478 - Culvert Replacement at 5100 Cromwell Marine Creek Rd.	This project removed a hazardous low water crossing on Cromwell Marine Creek Road and replaced it with a bridge, thus reducing hazardous street flooding at a school and eliminating the need for a 3.3 mile detour for over 800 properties.
00479 - Grassland Court	This project reduced repetitive flooding to homes on Crosswind Drive and Skylake Drive by construction of an expanded storm drain system.
00480 - Wedgwood Drainage Improvements	This project reduces home flooding by constructing storm drain improvements.
00482 - Milam-Robinhood Drainage Improvements	The project reduces flooding to streets and homes by adding a relief storm drain system at Milam Street, Robinhood Lane, and Norma Street.
00483 - Fossil Drive Drainage Improvements	This project reduces street, home, and school flooding in front of Riverside Elementary School by extending the existing storm drain system on Fossil at Wesley to Fairview.
00483 - Kings Oak Drainage Improvements	This project reduces street flooding by adding a storm drain system with inlets in the Kings Oak subdivision.

00483 - Tom Ellen/Long Drainage Improvements	This project reduces street flooding by adding a storm drain system with inlets on Tom Ellen between Williams and Fairview.
00484 - Kermit-Bonnie Drainage Improvements	This project reduces street flooding at Kermit-Bonnie by constructing enlarged culverts/mains, new inlets, and added a storm drain system.
00484 - Merida Ave Drainage Improvements	This project reduces street flooding at Merida Avenue by constructing enlarged culverts/mains, new inlets, and expanding the drainage system.
00484 - Waverly Park Drainage Improvements	This project reduces street flooding at Waverly Park by expanding the storm drain system.
00484 -Sarita Channel Drainage Improvements	This project rehabilitated Sarita Channel.
00486 - Tony's Creek Detention Rehabilitation	This project restored Tony's Creek Detention Pond where it had deteriorated due to erosion. The project extended the existing gabion mattress and used fiber reinforced embankment to address areas of erosion. A storm drain pipe was installed with inlets to prevent rill erosion caused by sheet flow across the adjacent parking lot.
00533 - Stone Wood Addn.	This project extended a culvert to reduce home flooding.
00625 - Longstraw Channel Improvements Major Drainage	This project repaired and widened the existing concrete channel from Strawberry to Beach and constructed new maintenance access ramps. The project will address issues in the Longstraw Channel.
00628 - Scott-Sunset Drainage Improvements	This project reduces residential flooding in the Deavers and Sunset Ridge Additions by constructing a new storm drain system.
00629 - Quail Run Drainage Improvements	This project constructed a new storm drain system to mitigate flooding to homes along Quail Run Road from Burton Hill Road to the end of Quail Run.
00630 - Westcreek-Kellis Park Drainage Improvements	This project reduces home and hazardous street flooding by increasing the capacity of the culvert and adding inlets on Westcreek Drive from Bilglade north to Kellis Park.
00633 - Lower Krauss-Baker Channel Improvements (Revised CP 00475)	This project protects properties from channel bank failure by construction of gabion mattresses.
00658 - Terminal-Deen Storm Drain Extension	This project reduces home flooding by replacing the undersized storm drain system along Zwolle and Beaumont from Deen to the Lebow Channel.
00660 - Raider / South Pipeline Channel Improvements	This project reduces flooding to commercial businesses by replacement of culverts across South Pipeline Road and improving the capacity of the channel.
00666 - Meacham Blvd. - Mark IV Drainage Improvements	This project reduces street flooding by adding additional pipes and manholes and increasing the capacity of the existing channel.

00670 - Edgehill Road Storm Drain Extension	This project reduces street, residential, and commercial flooding in the Ridglea neighborhood south of Camp Bowie along Edge Hill Road by installing an enlarged and expanded storm drain system.
00672 - Upper Sierra Vista Improvements	This project reconstructed a portion of Mississippi Channel to detain backwater from the undersized railroad culvert immediately downstream and to reduce apartment and neighborhood street flooding.
00674 - Forest Park-Parkview Storm Drain Rehabilitation	This project reduces street and commercial flooding and address structural failures in an existing culvert system in the Leslie Creek drainage area by increasing the capacity of the downstream storm drains out falling into the Trinity River.
00677 - Charron Court Storm Drain Extension SD #0228	This project reduces home flooding by construction of a new storm drain system to alleviate drainage from Charron Court onto properties on Shadow Drive.
00701 - Flaxseed Drainage Improvement	This project reduces flooding to homes in the 300 block of Flaxseed and Goldfinch by the construction of additional inlets.
00702 - Randol Mill Culvert Improvement	This project removes a hazardous roadway crossing by construction of a bridge on a new alignment of Randol Mill Road.
00703 - Provine Outfall and Drainage Improvements	This project reduces home flooding by upsizing the storm drain system.
00704 - Rolling Hills Addition	This project reduces flooding to homes west of Ellis Ranch Trail, Kingsdale, Ridgeview and Briardale by replacing the undersized and inadequate storm drain system in the area.
00778 - Lebow Channel - Dewey	This project reduces flooding by replacing the undersized bridge structure on Dewey over the Lebow Channel.
00778 - Lebow Channel - 28th Street	This project reduces flooding by replacing the undersized bridge structure on 28th Street over the Lebow Channel.
00779 - Mercado Channel	This project reduces flooding in a commercial area off Main Street by expanding the capacity of Mercado Channel from Marine Creek to 20th Street.
00942 - Clary Bird & Bonnie Brae reconstruction	This project reduces flooding by the construction of additional inlets and replacement of existing pipes and inlets in conjunction with a major street reconstruction project of Bonnie Brae (Yucca to Belknap), Clary (Riverside to Seaman), and Bird (Riverside east to cul-de-sac).
00951 - Kearney street reconstruction	This project reduces flooding by the construction of a new storm drain system at 33rd Street in conjunction with a major street reconstruction project on Kearney from Loraine east to 35th Street.
00961 - Lincoln Ave	This project reduces home flooding by enlarging the storm drain system in conjunction with a major street reconstruction project on Lincoln Ave from 16th Street to 23rd Street.
00964 - Parsons Lane street reconstruction and drainage improvements	This project reduces home flooding by installing a new storm drain system from Decatur to 1017 Parsons Lane and adding inlets in conjunction with a street reconstruction project to Parsons Lane from Hardy to Blue Mound Road.

01023 - Summercrest Drainage Improvements	This project reduces home flooding by construction of a greatly enlarged storm drain system within Cloudview Road, Briarhaven Road, Summercrest Drive, Trails Edge Road, and within an easement from the east end of Briarhaven to a new outfall in the Sarita Channel.
1069 - 7424 Lockwood Court Drainage Improvements	This project reduces flooding to homes on Lockwood by replacing the undersized culvert.
1081 - Bellaire Park Court Drainage Improvement	This project reduces flooding in the Tanglewood neighborhood by installation of a storm drain relief line.
01119 - Ruidosa-Bandera Drainage Improvements	This project reduces flooding to residential properties by construction of a new storm drain in Ruidosa Trail, Bandera Road and Geronimo Trail.
01293 - Silver Creek Road Improvements	This project reduces flooding near Brewer High School by constructing culvert and channel improvements.
01335 - Crooked Lane Drainage Improvements	This project reduces home flooding on Crooked Lane by constructing a parallel storm drain line and additional inlets.
01363 - Eastern Hills Phase I	This project reduces church flooding upstream and alleviates downstream flooding by construction of a regional detention basin and a storm drain system.
01364 - West Downtown Structural Rehabilitation at 10th Street	This project rehabilitated the failing storm drain structure along 10th St. between Cherry St. and Lamar St.
01604 - Lake Crest Drainage Improvements	This project reduces home and street flooding within the Lake Crest Estates Addition in northwest Fort Worth through various drainage improvements.
01918 - Ashland Drainage Improvements	This project reduces home and street flooding in the Central Arlington Heights area through the construction of underground detention north of El Campo on Ashland.
02054 - BNSF Tower 55 - Gounah Street from Samuels Ave to BNSR Railroad	This project reduces street flooding by construction of inlets and piping for the reconstruction of Gounah Street from Samuels Ave to BNSR Railroad.
00093 - S. Timberline Dr. Drainage Improvements (SD-0362)	This project reduces street and home flooding on South Timberline Drive by adding inlets and upsizing the pipes.
00094 - Minor Misc. Storm Drain Improvements at 2244 Winton Terrace (SD #0240 X-21243)	This project reduces home flooding by replacing a collapsed pipe and inlet on Winton Terrace.
00094 - Minor Misc. Storm Drain Improvements at 7504 Skylake (SD #0240 X-21243)	This project reduces home flooding on Skylake by the construction of storm drain pipe and inlets.
00480 - 150 Victorian Court Drainage Improvements	This project reduces street and property flooding by installing storm drain pipe and inlet.

00476 - Glen Garden West Drainage Improvement	This project reduces several areas of home flooding in the Glen Garden neighborhood by construction of relief storm drain improvements.
00482 - Wilbarger-Hughes Drainage Improvements (SD #0251)	This project reduces home flooding on Hughes Avenue through improving storm drains and inlets along Wilbarger at Hughes Avenue and Tahoe Street.
00483 - Yolanda/Meadowlane Terrace Drainage Improvements (SD #0307)	This project reduces home and street flooding by installing a storm drain system on Meadowlane Terrace and Yolanda.
1074 - Tulsa Way Drainage Improvement (SD #0315)	This project reduces residential and commercial property flooding through the installation of a relief storm drain system along Tulsa Way and Camp Bowie.
01364 - West Downtown Structural Rehabilitation at Lipscomb St.	This project rehabilitated the storm drain along Lipscomb St. between Pennsylvania Ave. and Broadway Avenue.
SD #0316 & #0317	This project reduces flooding to homes by constructing inlet improvements on Black Canyon, Ardorlawn, and Briarhaven at Bellaire.
SD #0318	This project reduces flooding to homes by regrading bar ditches and installing storm drain pipe and end treatments at driveways.
SD #0358 - Cantey Street Drainage Improvements	This project reduces residential flooding on Cantey Street by constructing concrete alley to channelize the drainage.
01850 - White Lake Hills Drainage Improvements - Willow Ridge	This project reduces home flooding through the installation of a storm drain system.
SD #0303 - Panther Heights Drainage Improvements	This project reduces flooding to homes through various drainage improvements.
SD #0304 - Clay Court Drainage Improvements	This project reduces flooding to homes through the installation of storm drain improvements.
SD #0305 - Stadium Drive Drainage Improvements	This project reduces flooding to homes on Stadium Drive through the installation of storm drain improvements.
SD #0308 - 6th Ave at Ripy Street Drainage Improvements	This project reduces flooding to homes by adding inlets.
SD #0322 - North Tarrant Parkway at Park Vista	This project rehabilitated failing drainage features along North Tarrant Parkway.
SD #0332 - Bluebonnett Circle	This project rehabilitated structure failure through storm drain improvements.
SD #0333 - Capps Road at College Ave	This project reduces street flooding by upsizing an existing section of storm drain as part of a street reconstruction project.
SD #0336 - Hilltop Road Drainage Improvement	This project reduces home flooding by adding inlets on Hilltop Road.
SD #0359 - 1012 Fairweather Drainage Improvement	This project reduces street flooding by installing various drainage improvements.

SD #0360 - W Elizabeth Drainage Improvement	This project rehabilitated a failed structure by installing a storm drain system.
SD #0361 - 14th St at Homan Ave Drainage Improvement	This project reduces street flooding by installing a storm drain system.
01137 - SD #0362 - Trinity at Norwood Drainage Improvement	This project reduces street flooding by installing a storm drain system.
01137 - SD #0348 - Weatherford at Commerce Drainage Improvement	This project rehabilitated a collapsed storm drain system.
01137 - 5th Avenue at Magnolia	This project reduces commercial building flooding through the addition of inlets.
01137 - 7th Street at Boland Street	This project reduces commercial building flooding through the addition of inlets.
01137 - 1808 Gould Street: Emergency Cave-in	This project replaced collapsed storm drain line.
01137 - 6th Avenue at Roberts Street: Emergency cave-in	This project replaced collapsed storm drain line.
01137 - Coffee Tree Detention Pond	This project rehabilitated a detention basin and outlet structure.
01137 - N. Rivercrest Drainage Improvement	This project replaced collapsed storm drain line.
01137 - Curzon at Bigham (Monnig MS)	This project reduces the flooding of school property by increasing the capacity of the storm drain system.
01137 - Harrington Ave Inlet replacement	This project rehabilitated a failed structure by replacing an inlet.
01137 - Central Handley at Lancaster	This project rehabilitated a failed structure by replacing an inlet.
1832 Junius Street pipe replacement	This project rehabilitated a failed structure by replacing a storm drain pipe.
01635 - W. Caylor Road at Oak Leaf Trail Drainage Improvement	This project reduces street flooding through various drainage improvements.
01635 - Bourbon Street	This project reduces street flooding through the installation of a storm drain system.
01635 - McCandless Drainage Improvements (SD #0357)	This project rehabilitated a failed structure by replacing a storm drain pipe.
01137 - Cromwell at Riverside (SD #0363)	This project rehabilitated a failed structure by replacing a storm drain pipe.
01874 - Bedell Street Drainage Improvement	This project reduces street flooding through the installation of a storm drain system.

01874 - Broadus Street Drainage Improvement	This project reduces street flooding through the installation of a storm drain system.
01892 - Harlanwood Storm Drain Improvements	This project reduces home flooding through the construction of a new storm drain system at Lynncrest and Harlanwood.
00961 - Lincoln Ave Drainage Improvement	This project reduces home and street flooding through realignment of the storm drain trunk line.
Quanah Parker Park	This project addressed erosion failure in Quanah Parker Park through various drainage improvements.
Luella Merrit detention facility	This project reduces home flooding through the construction of a regional detention pond at Louella Merrit Elementary School.
Ballinger at 1300 W. Lancaster inlet replacement	This project reduces flooding through installation of storm drain improvements.
Woodstream Drainage Improvements	This project reduces school and street flooding through the installation of storm drain improvements.
White Settlement @ Silver Ridge Blvd	This project reduces street flooding through the installation of storm drain improvements.
01615- Verna Trail- Paint Pony Trail Drainage Improvements	This project reduces home and street flooding within the Tejas Trails neighborhood in far west Fort Worth through various drainage improvements.
1776- Central Arlington Heights Drainage Improvements	This project reduces home and street flooding in the Central Arlington Heights area through the construction of underground detention on Bryce and Western and above ground detention on Western.
01598 - Cooks Children's Hospital at 7th Ave. Drainage Improvements	This project constructed storm drain improvements to reduce flooding in the hospital district.
01967 - HMAC Surface Overlay	This project reduces home flooding through the construction of storm drain improvements to accompany street repaving projects.
00956 - Refugio	This project reduces home flooding by installation of a new storm drain system.

Table C-8: Insurance Claims and Payouts

Year	Claims	$
1978	1	$483
1979	13	$22,495
1980	1	$414
1981	48	$218,408
1982	27	$77,046
1983	9	$30,197
1984	1	$0
1985	2	$2,181
1986	27	$181,225
1987	9	$38,717
1988	1	$1,390
1989	41	$228,625
1990	63	$694,549
1991	20	$138,173
1992	9	$75,386
1993	6	$33,751
1994	3	$2,425
1995	21	$86,907
1996	1	$759
1997	7	$4,543
1998	2	$902
1999	2	$2,470
2000	9	$88,916
2001	13	$122,584
2002	15	$39,276
2003	5	$9,420
2004	45	$598,085
2005	2	$8,078
2006	4	$10,287
2007	45	$719,301
2008	5	$28,131
2009	15	$80,464
2010	19	$123,076
2011	1	$0
2012	3	$1,529
2013	2	$13,264
2014	14	$388,500
Total	511	$4,071,957

Table C-9: City of Fort Worth Stormwater Division Current and Potential Mitigation Activities

Mitigation Activity Type	What we are currently doing	What we could potentially do
Preventative Activities	Floodplain mapping- FEMA and potential areas of high water	Special zoning outside the FEMA floodplain but within areas of potential high water
	Drainage system maintenance- inlet program	Open channel inspections
	Vegetation maintenance program	Use criticality (business risk exposure)information for maintenance actions, planning, etc.
	Dam inspections	Perform a channel inventory (earthen, concrete, natural, manmade, etc.) to understand what we have and better determine maintenance needs, etc.
	Maintenance agreement inspections	Establish green infrastructure regulations (only voluntary now)
	Bridge inspections	Establish a CCTV program
	Pre and post rain event inspections on 300 locations (known areas of issues)	Establish a stormwater in lieu of fees program for developers to pay into regional SW improvements
	Water quality device inspections and cleaning	
	Maintain a GIS inventory of stormwater assets	Enhance the stormwater inventory we have
	Using the potential areas of high water information to make better planning decisions	
	Development review/iSWM criteria	
	Inlet marker program	
	Enhanced floodplain regulations	
Property Protection	Maintenance agreements	Buyout plan/program
	Citywide mailer to enhance insurance awareness and knowledge	
	Letters to RL or frequently flooded areas	Refine who receives these letters- expand audience as appropriate
	Sewer back up protection (water department)	
Natural Resource Protection	Native grass planting program for channel maintenance	Establish green infrastructure regulations (only voluntary now) to improve water quality

Natural Resource Protection	Native plant program participate with Water Conservation and NCTCOG	Expand existing native grass planting program
	Reverse Litter Program	ID Citywide water quality protection zones and establish regulations for them
	Stormwater credit program for nonresidential	
	iSWM review for erosion and sediment control	
	Geomorphological assessments for highly erosive areas	
Emergency Services	Pre and post rain event inspections on 300 locations (known areas of issues)	Establish flood warning system
	Block streets that become flooded- barricade list	Online mapping of current road closures, detours, etc. during flood events (waze?)
	Current high water warning system (50+ sites)	More emphasis on real time flood forecasting
		Look into grant funding for emergency services
	Nixle, twitter, Facebook, City website- social media	
Structural Projects	Low water crossings	Regional SW system project such as regional detention
	Regional stormwater detention	Low water crossings- do more, upgrade existing crossings to improve service levels
	Local stormwater detention	Pipe burst to increase capacity
	Pipe system improvements	Stormwater pipe rehab program
	Partnership with Ft Worth ISD for stormwater detention	More local stormwater detention projects
	TRWD coordination	More pipe system improvements to increase service levels
	Open channel improvements	Increase capacity of existing culverts or/and bridges
	Ongoing maintenance	Continue ongoing maintenance
	Coordination with other City departments on drainage requirements for City projects	
	Making the public aware of areas of potential high water- on the planning & zoning website	Flood awareness week (be more active)

Public Information	Curriculum developed of stormwater educational materials	Interpretive signage in appropriate areas to discuss natural resource protection, stormwater systems, etc.
	Yard Smart twice a year (fall and spring)	Enhance our program to make flood hazard information available to the public
	Inlet marker program	Move our flood safety awareness week to October to be consistent with TFMA
	School credit program to reduce SW utility fees if schools provide education during the school year	Targeted meetings to neighborhoods that aren't in the FEMA floodplain but are in RL areas or highly flood prone areas such as Central Arlington Heights, etc.
	West Nile education	Target meetings in extreme regions (far north, newly annexed areas, etc.) to share messaging
	Partnership programs: FEMA in Protect What Matters, TRWD in Reverse Litter and adopt an inlet program, COG in campaign to not have lawn companies not blow things into storm drains and pet waste education, internally partner with office of emergency mgmt on know what to do program (turn around don't drown), internally partner with keep fort worth beautiful to promote protecting water quality, adopt a creek	Develop a library of models that the public can use
		Direct mail of FEMA products to targeted areas
		Paid advertising- print, PSA, etc.
		Contest participation to design manhole lids, design educational signage, etc.
	LIDs- rain barrel sales in partnership with BRIT and with several internal departments (ENV and Water), native plants through COG and Water Department Water Conservation Group and ENV,	Participate in Mayfest and Main Street Art Festival

Public Information	City website, City news that media can check to mine for stories, opportunistic stories with media to promote SW program, water bill inserts (City Times), twice a year paid water bill insert,	Expand curriculum to other ISDs in Fort Worth
	Community Engagement Office- direct link to 200+ neighborhood associations- attend meetings and give our message on our behalf, host twice a year Neighborhood University to train neighborhood leaders with our message (flood safety, protection, etc.), outreach at community events- Cowtown cleanup, Earth Day, Yard Smart twice a year, Waterama, and many smaller ones such as speaking at school groups, civic groups, boy scouts, etc.	Establish policy papers to interpret grey areas or guidance based on experience (Development Review Group function)
	Social media- use Facebook, twitter, City website, My sidewalk, Nixle, Next Door, subscriber email database - once a week City News email blast and quarter Eco Insider email	Hold regularly scheduled sessions to discuss stormwater related topics such as LID, water quality, development review subjects, etc.
	Hold events to feature specific projects (and share messaging)	
	Direct mail of newsletter once a year to all water subscribers and rate payers	

Appendix D

Coordination with other Communities and Agencies

FREESE AND NICHOLS

Innovative approaches
Practical results
Outstanding service

4055 International Plaza, Suite 200 • Fort Worth, Texas 76109 • 817-735-7300 • fax 817-735-7492 www.freese.com

Date

Contact Name, Position
Entity
Mailing Address
City, TX zip

RE: Floodplain Management Plan for the City of Fort Worth

Dear Contact:

The City of Fort Worth is in the process of preparing a Floodplain Management Plan. Freese and Nichols, Inc. is helping prepare this plan on behalf of the City. This plan will identify flood risks, their impact on the community, and a prioritized action plan for reducing flood risks. The City is also developing a Repetitive Loss Area Analysis to create a detailed mitigation plan for all its identified repetitive loss areas. By completing the plan and analyses, the City will be on a path to becoming safer and more resilient to flooding hazards. These two plans will also improve Fort Worth's National Flood Insurance Program (NFIP) Community Rating system (CRS) score. Improving the City's CRS score will reduce eligible flood insurance premiums, which will save money for residents and businesses. One of the key elements in this plan is to coordinate with other agencies and organizations to incorporate existing information. With that in mind, please consider the following requests:

1. Do you have any data or information pertinent to the development of this floodplain management plan?
2. Are you aware of any projects that might affect flooding or properties in flood-prone areas within the City of Fort Worth?

We would also like to extend an invitation for you to attend a meeting and/or comment on the draft plan and repetitive loss analyses for this project. Your input and feedback is greatly appreciated. For additional information, including notices of upcoming meetings and relevant documents, please visit our project website: http://fortworthtexas.gov/stormwater/floodplain/

Comments and responses can be submitted to me at the contact information below or to Clair Davis, P.E., CFM, Floodplain Administrator, City of Fort Worth, 1000 Throckmorton, Fort Worth, Texas 76102, clair.davis@fortworthtexas.gov, or 817-392-5981.

Sincerely,

Scott Hubley, P.E., CFM
Project Manager
Freese and Nichols, Inc.
4055 International Plaza, Suite 200
Fort Worth, TX 76109
skh@freese.com

cc: File

Table D-1: Agencies/Communities Solicited for Information

Name	Agency/Organization	Position	Response
Mandy Clark	City of Arlington	Stormwater Engineering Operations Manager	
Rick White	City of Azle	Public Service Director	
Bennett Howell	City of Benbrook	Director of Public Services	Yes
Michelle McCullough	City of Burleson	Floodplain Administrator	Yes
Jim McDonald	City of Crowley	Director of Public Works	
Hal Cranor	City of Euless	Director of Public Works	
Stephanie Griffin	City of Grand Prairie	Floodplain Administrator	yes
Tom Ice	City of Haltom City	City Engineer/Asst Public Works Director	
Ron Haynes	City of Hurst	Director of Public Works	Yes
Garry Fennel	City of Irving	Floodplain Administrator	
Keith Fisher	City of Keller	Public Works Director	
Larry Ledbetter	City of Kennedale	Director of Public Works	
Sean Densmore	City of Lake Worth	Director of Public Works	
Michael Barnes	City of Richland Hills	Floodplain Administrator	
Cody Petree	City of Roanoke	Director of Development Services	
Mark White	City of Saginaw	Director of Public Works/Community Development	
	City of Watauga	Public Works Director	
Roger Unger	City of Westworth Village	City Administrator	
Jack Bell	City of White Settlement	Public Works Project Manager	
Joe Trammel	Tarrant County	County Engineer	
David Marshall	Tarrant Regional Water District	Director of Engineering and operations Support	
Jack Tidwell	North Central Texas Council of Governments	Manager of Environment & Development	
Michael Segner	Texas Water Development Board	Director, NFIP State Coordinator	
Rafael Rayes	Texas Department of Emergency Management	District Coordinator	Yes
Dale Hoff	FEMA Region VI	Compliance Specialist	
Greg Story	National Weather Service	Meteoroligist	
Craig Loftin	United States Army Corps of Engineers	Hydrology and Hydraulics Section	
Timothy Raines	United States Geological Survey	North Texas Program Office Chief	
Michael Brooks	Natural Resources Conservation Service	District Conservationist	

Responses from Communities and Agencies

Scott Hubley

From: Bennett Howell <BHowell@benbrook-tx.gov>
Sent: Monday, July 06, 2015 1:43 PM
To: Scott Hubley
Subject: Fort Worth Floodplain issues

Scott,
I received your letter regarding the City of Fort Worth and Floodplain Management. Currently, I am only aware of a couple of projects in Fort Worth that may impact the City of Benbrook:

- Mary's Creek Study – this project has seemed to take on a mind of its own with no end in sight. I am not sure if any data has been submitted to FEMA for review.
- A subdivision is proposed in the area around Aledo Road and RM 2871 and this area drains through Benbrook. Benbrook has not seen any plans on it yet so I am not sure of the impact on Benbrook.

I am not aware of any other proposed projects that could impact Benbrook.

Thanks

Bennett C. Howell, III, PE, CFM
Director of Public Services
City of Benbrook
911 Winscott Road
Benbrook, Texas 76126
(817) 249-6063

Scott Hubley

From: Michelle McCullough <mmccullough@burlesontx.com>
Sent: Monday, July 20, 2015 3:49 PM
To: Scott Hubley
Subject: July 2, 2015 Letter regarding FW

Scott:

I just received this letter last week. I am not sure how you would like for me to respond so I am going with email. To my knowledge I don't think we have any projects at this time that might affect flooding or properties in flood prone area near the city limits of FW or within nor would we have any pertinent information to my knowledge.

I am not sure if you have sent correspondence to David Disheroon in the county but he may have some information since I believe some of FW's ETJ they deal with.

Michelle McCullough, P.E., CFM
Civil Engineer
City of Burleson
141 W Renfro Street
Burleson, Texas 76028
www.burlesontx.com
817.426.9616

Scott Hubley

From: Greg Dickens <GDickens@hursttx.gov>
Sent: Friday, July 10, 2015 1:32 PM
To: Scott Hubley
Cc: Ron Haynes
Subject: Floodplain Management Plan for the City of Fort Worth

Scott,
The City of Hurst does not have any data or information pertinent to this plan and is not aware of any projects that might affect flooding in Fort Worth. Call me if you want to discuss anything about Hurst further.

Gregory W. Dickens, P.E., C.F.M. | CIty Engineer
Direct: 817-788-7080 | City of Hurst, Texas
Website: www.hursttx.gov

Scott Hubley

From: Davis, Clair <Clair.Davis@fortworthtexas.gov>
Sent: Friday, July 17, 2015 11:52 AM
To: Scott Hubley
Cc: Sterne, Linda
Subject: FW: Ft. Worth Floodplain Management Plan
Attachments: Floodplain Management Plan.pdf

Scott, Linda,
Here's a response from TDEM/TDPS regarding our FMP. I think we've gotten a couple other responses that we need to be sure we're consolidating.

Thanks,

Clair

Clair C. Davis, P.E., CFM
Floodplain Administrator

City of Fort Worth
T/PW Stormwater Management
1000 Throckmorton Street
Fort Worth, TX 76102
817-392-5981 (office)
How well am I serving you? You can contact my supervisor, greg.simmons@FortWorthTexas.gov with comments.

From: Reyes, Rafael [mailto:Rafael.Reyes@dps.texas.gov]
Sent: Friday, July 17, 2015 10:29 AM
To: Davis, Clair
Cc: Webster, Jay; Penney, Marty; Webster, Jack; Bradberry, Michael
Subject: Ft. Worth Floodplain Management Plan

Good Morning Ms. Davis,
My name is Rafael Reyes. I'm the District Coordinator for DDC 04 Hurst, with the Department of Public Safety and the Texas Division of Emergency Management. The Texas Division of Emergency Management received the attached letter. There were two questions that were presented to us in the letter. With those questions, we provide the following responses.

1. Do you have any data or information pertinent to the development of this floodplain management plan?
   At this time, we do not have any information that is pertinent to the development of your plan.

2. Are you aware of any projects that might affect flooding or properties in flood-prone areas within the City of Fort Worth?
   While there are several freeway and road projects currently in the works in the City of Ft. Worth, we do not have any data nor do we have much information reference the effects of flooding. Recently, Flash flooding did occur because of the amount of rain that came down. During the recent flooding events, Ft. Worth seemed to prove they were a hardened

community, as not many incidents were reported to DDC 04 Hurst. One event that was reported was a "Potential for Lake Benbrook to go over the spillway. This will close Dirk RD between Wainscot and Pecan Valley.".

Ms. Davis, I will be in attendance for your August 4th meeting. If there is something else you need from TDEM reference this subject, please feel free to contact me.

Respectfully,

Rafael Reyes
District Coordinator, Field Response Section
DDC 04 Hurst
Texas Division of Emergency Management
Texas Homeland Security
Texas Department of Public Safety
624 Northeast Loop 820
Hurst, Texas 76053
O: (817) 299-1474
M: (940) 452-7757
Rafael.Reyes@dps.texas.gov
www.txdps.state.tx.us/tdem

From: Stephanie Griffin [mailto:sgriffin@GPTX.org]
Sent: Friday, September 11, 2015 12:03 PM
To: Scott Hubley <skh@freese.com>
Cc: Davis, Clair <Clair.Davis@fortworthtexas.gov>; Robinson, Cindy <Cindy.Robinson@fortworthtexas.gov>
Subject: Fort Worth FMP

Scott-
I received your letter regarding the Fort Worth Floodplain Management Plan in early July. Unfortunately, the letter arrived as I was dealing with the documentation of flooded structures and the resulting FEMA and other regulatory agency site visits.

I am not aware of any information that Grand Prairie has that would be useful in the development of this plan. Most of Grand Prairie's watershed studies are available on our website. I just realized this week in working on my own CRS documentation updates that a few of Grand Prairie's watershed master plans are not currently available online. I am working to get those added in the near future. Fort Worth is welcome to use any of these studies that are of interest to the City.

Clair and I have worked together recently on a project (Pettigrew) that is partially located in Fort Worth and Grand Prairie and is in the floodplain. Clair took the lead on coordinating the CDC permitting review and both cities signed the final action form. Both cities required floodplain development permits for the proposed development. At this time, I have completed my review of the Grand Prairie floodplain development permit application and am awaiting the floodplain development permit application fee so I can release the permit.

I am not aware of any future developments along our shared city boundary. However, I intend to contact Clair when developers present projects that have property in both Grand Prairie and Fort Worth. The approach on the Pettigrew property worked well.

I am happy to review the Fort Worth draft FMP if that would be helpful to them. I apologize for the delay in responding to your letter.

Sincerely,
Stephanie

Stephanie W. Griffin, P.E., CFM
Stormwater Utility Manager / Floodplain Administrator
City of Grand Prairie
206 W. Church St.
Grand Prairie, TX 75050
P: (972) 237-8150
sgriffin@gptx.org

Appendix E

CRS Self-Score

Table E-1: CRS Self-Score

CRS Step	Maximum Score	Self Score
1. Organize to prepare the plan	**15**	**10**
a. Involvement of Office Responsible for Community Planning	4	4
b. Planning committee of department staff	9	6
c. Process formally created by the community's governing board	2	
2. Involve the public	**120**	**115**
a. Planning process conducted through a planning committee	60	60
b. Public meetings held at the beginning of the planning process	15	15
c. Public meeting held on draft plan	15	15
d. Other public information activities to encourage input	30	25
3. Coordinate with other agencies	**35**	**34**
a. Review of existing studies and plans ***(REQUIRED)***	5	5
b. Coordinating with communities and other agencies	30	29
4. Assess the hazard	**35**	**30**
a. Plan includes an assessment of the flood hazard with: ***(REQUIRED)***		
(1) A map of known flood hazards	5	5
(2) A description of known flood hazard	5	5
(3) A discussion of past floods	10	5
b. Plan includes assessment of less frequent floods	10	10
c. Plan includes assessment of areas likely to flood	5	5
d. The plan describes other natural hazards ***(REQUIRED FOR DMA)***	5	
5. Assess the problem	**52**	**37**
a. Summary of each hazard identified in the hazard assessment and their community impact ***(REQUIRED)***	2	2
b. Description of the impact of the hazards on:	25	
(1) Life, safety, health, procedures for warning and evacuation	5	5
(2) Public health including health hazards to floodwaters/mold	5	5
(3) Critical facilities and infrastructure	5	5
(4) The community's economy and tax base	5	5
(5) Number and type of affected buildings	5	5
c. Review of all damaged buildings/flood insurance claims	5	5
d. Areas that provide natural floodplain functions	5	5
e. Development/redevelopment/population trends	7	
f. Impact of future flooding conditions outlined in Step 4, item c	8	

Table E-1: CRS Self-Score

CRS Step	Maximum Score	Self Score
6. Set goals *(REQUIRED)*	**2**	**2**
7. Review possible activities	**35**	**35**
a. Preventive activities	5	5
b. Review to determine if regulatory standards are sufficient for present and future	5	5
c. Property protection activities	5	5
d. Natural resource protection activities	5	5
e. Emergency services activities	5	5
f. Structural projects	5	5
g. Public information activities	5	5
8. Draft an action plan	**60**	**45**
a. Actions must be prioritized ***(REQUIRED)***		
(1) Recommendations for activities from two of the six categories	10	
(2) Recommendations for activities from three of the six categories	20	
(3) Recommendations for activities from four of the six categories	30	
(4) Recommendations for activities from five of the six categories	45	45
b. Post-disaster mitigation policies and procedures	10	
c. Action items for mitigation of other hazards	5	
9. Adopt the plan	**2**	**2**
10. Implement, evaluate and revise	**26**	**26**
a. Procedures to monitor and recommend revisions ***(REQUIRED)***	2	2
b. Same planning committee or successor committee that qualifies under Section 511.a.2 (a) does the evaluation	24	24
Total Score	**382**	**336**

*The total score is the sum of the scores for the 10 bolded CRS steps.

Appendix F

Supplementary Content on CD